

GBPPR 'Zine



Issue #10 / The Monthly Journal of the American Hacker / January 2005

Welcome to **Green Bay Professional Packet Radio's** (www.gbppr.org) crappy magazine!

Happy New Year you scum! Here are some nice, helpful New Year's resolutions for you slackers:

- ◆ Cancel subscription(s) to \$2600. Emmanuel Golddigger can find a real job.
- ◆ Stop jerkin' it to Emmanuel Golddigger's little cash cows.
- ◆ Stop being a dumbass.
- ◆ Read and help redistribute *GBPPR 'Zine*.
- ◆ Stop raping goats.
- ◆ Kill yourself.

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An Introduction to Fiber Optic Communications

Why Fiber Optics?

In the last decade, optical fiber transmission systems have come to dominate the market for high-bit-rate transmission systems. Indeed, they have redefined "high-bit-rate", a term which used to only apply to 45 Mbps transmission systems, but now may apply to systems carrying billions-of-bits (gigabit) of information per second.

Optical fiber has been replacing older carriers such as copper wire, coaxial cable, and microwave radio due to its incredible *bandwidth*. Bandwidth is the information capacity of any carrier, and is roughly proportional to the frequency of that carrier. The higher you go in the electromagnetic spectrum, the more information you can transmit. With present technology, lightwaves are as far as we can go in transmitting useful information. (*Refer to Figure 1*)

Early Examples of Optical Communications

There have been many attempts to harness lightwaves for communication purposes. Some were more successful than others:

- Smoke signals by North American Indians.
- British naval flag signaling systems.
- Alexander Graham Bell's *photophone*.

The above methods all shared one common disadvantage – they were using the Earth's atmosphere as the transmission medium. The atmosphere is terribly unpredictable and rain or fog can block the communication path. Line-of-sight communication is usually required, which places a sharp limit on the transmitting distance. Finally, high-intensity optical sources can actually pose a hazard to the public!

Beginnings of Fiber Optic Communications

The first indication that "light pipes" might be possible came in the late 1870s. A British physicist, Taylor Tyndall, discovered that a jet of water could guide a beam of light through gentle curves. This was explained by another British physicist, James Clerk Maxwell, with his invention of electromagnetic theory. He proved that, under certain boundary conditions between different substances (such as water and air), light would exhibit *total internal reflection*.

Naturally, 19th century technology did not permit development of fiber optic transmission systems. By the 1960s, the boom in solid-state technology led to a new look at optical communications. Within a decade, three separate pieces of the puzzle came together. Photodiodes allowed the detection of very weak light pulses in a compact and rugged package. Semiconductor lasers provided tiny but very intense sources of monochromatic (single color) light. And material scientists specializing in the properties of glass learned how to mass-produce very thin, very transparent glass fibers.

The first "low loss" fiber was manufactured in the early 1970s. (12 dB of loss per mile may not be "low loss" today, but it was a breakthrough at the time.) Improvements followed rapidly, so that fiber attenuations of well below 0.5 dB/mi are readily available today. These exceptional transparencies allowed the design of transmission systems with regenerator (repeater) spacings far beyond anything available with copper carriers.

Advantages of Fiber Optics

Consequently, fiber optic systems were brought to market with two great driving forces. First, the incredible bandwidth of optical systems meant that transmission networks could now plan on megabits – or gigabits – where they had used kilobits before. Second, fiber systems could attain regenerator spacings of up to 30 miles – compared to approximately one mile for copper.

In addition; however, there were many "bonus" features of using fiber optic transmission systems. These include:

- Small sized cables eased the installation in crowded wiring ducts.
- Lightweight cables allowed for longer runs.
- Immunity to any electrical interference. (crosstalk, induction, etc.)
- Security from unauthorized tapping.
- Upgradeability to higher bit rates as electronics improved.
- Low cost (as economies of scale came into play).

Basic Fiber Transmission System

Any fiber optic transmission system must contain these three basic components, a transmitter, a receiver, and optical fiber. For systems used in telephony applications, the optical transmitter is usually a semiconductor laser (although Light Emitting Diodes (LED) may be used in short-haul systems). The optical receiver may be a PIN diode or an avalanche photodiode. Finally, almost all telecommunications fiber installed today is singlemode (although there is a great deal of multimode fiber in the outside plant). *Refer to Figure 2*

Factors Influencing Viability

Any transmission system must make economic sense before it can be justified. Some of the factors that had to be addressed before fiber optics became feasible included:

Sources

- Speed
- Size
- Cost
- Reliability
- Environmental Stability
- Output Power

Detectors

- Speed
- Size
- Cost
- Reliability
- Environmental Stability
- Sensitivity

Medium (Fiber Cable)

- Size
- Loss
- Physical Integrity
- Cost
- Splicing Technology
- Connector Technology
- Manufacturability

Optical Sources

Optical sources convert electrical signals into optical signals for transmission over the fiber path. There are two types of optical sources generally available:

Light Emitting Diodes (LED)

LEDs are quite inexpensive and relatively rugged. However, they suffer from low output power (around -18 dBm), large chromatic width (40–50 nm), and resistance to high-speed modulation. For these reasons, LEDs have found their market in military or industrial applications where high-bit-rate or long transmission links are not required.

Semiconductor Lasers

Semiconductor lasers correct the failings of LED: they have very high output power (up to a milliwatt, or 0 dBm), very narrow chromatic width (2–5 nm), and very high modulation speed (in excess of 1 GHz). However, they are quite expensive and relatively sensitive to environmental effects (such as temperature). For most telecommunications applications, however, the benefits of using lasers far outweigh any drawbacks.

Optical Detectors

Optical detectors perform the reverse function – they convert incoming optical signals into electrical signals that can be processed with conventional circuitry. Again, there are two types of optical detectors commercially available:

PIN Diodes

PIN (Positive–Intrinsic–Negative) diodes have long been the mainstay of the fiber communications industry. They are relatively inexpensive and do not require great amounts of power. However, they are limited in sensitivity. PIN diodes are still an appropriate choice for many systems.

Avalanche Photodiodes

Avalanche photodiodes include amplification circuitry, so that very weak light pulses may be easily detected. They also can respond faster than traditional photodiodes, so that higher bit rates may be transmitted. Drawbacks include higher noise levels, increased power requirements, and significantly greater cost.

Other detection systems are currently being tested. Some, such as coherent technology, promise to greatly increase receiver sensitivities in the near future.

Types of Optical Fibers

Listed below are three basic types of optical fiber in use today:

- *Step-index multimode* fiber is mostly of historical interest, although it still finds many uses in industries less demanding than telecommunications.
- *Graded-index multimode* first brought optical fiber out of the laboratory and into the telephone network.
- *Singlemode* fiber has in only two or three years come to totally dominate the telecommunications marketplace, promising ever higher bit rates and repeater spacings.

Step-Index Multimode Fiber

Step-index multimode is an older type of fiber that is seldom used in telecommunications links today. It is still used in data communication and light-pipe applications, however. It may be fabricated from plastic or glass.

The different paths shown through the fiber are the different "modes". Obviously, since the paths have different lengths, transit times will vary between modes. This problem of "differential mode delay" severely limits the bandwidth available with this type of fiber. *Refer to Figure 3*

Graded-Index Multimode Fiber

Graded-index multimode fiber was developed to avoid the problems of differential mode delay. The refractive index (measurement of speed-of-light) of the core now varies with the distance from the center of the fiber. (A higher index indicates a lower speed-of-light.) Now, therefore, the path (mode) through the center is still the shortest, but is in the region of slowest travel. Paths near the edge of the core are longer, but the light travels faster. When correctly optimized, the transit time of all modes is equal.

A great deal of multimode fiber was installed in the late 1970s and early 1980s. However, the information capacity (bandwidth) was limited to approximately 150 Mbps. *Refer to Figure 4*

Singlemode Fiber

Singlemode fiber represents the current state-of-the-art in fiber manufacture. Since its commercial introduction in the early 1980s, it has come to totally dominate all fiber applications in the telecommunications industry.

By dramatically shrinking the fiber core, the number of possible paths through the fiber is reduced to one. With only singlemode being transmitted, the self-interference of differential mode delay is eliminated.

The bandwidth of singlemode fibers is exceptionally high. Transmission systems have been demonstrated operating at many gigabits-per-second (1 gigabit = 1 billion bits). *Refer to Figure 5*

Signal Impairments

There are many causes of signal impairments in optical transmission. These can be generally divided into *attenuation* (loss) and *dispersion*. *Refer to Figure 6*

Attenuation

Attenuation, or signal loss, simply indicates that the amount of light received depends on the length of the fiber being used. Attenuation may be caused by *absorption* (for example, the hydroxyl ion (OH) has a strong absorption peak near 1300 nm), by *scattering* from impurities in the fiber cable, or from *radiation* (light leakage or microbending). In most cases, attenuation problems have been overcome by increased precision and quality control during the manufacturing phases.

Dispersion

Dispersion is the tendency of light pulses to get "blurry" after travelling through a fiber. This limits the bandwidth of the fiber, since in extreme cases pulses begin to overlap and information is lost. In

multimode fiber, very high dispersion values are caused by differential mode delay – there are hundreds of possible paths for the light to follow through the fiber, and each path takes a slightly different amount of time. This problem is eliminated in singlemode fiber, so dispersion values are orders of magnitude lower. However, there is still a problem with *chromatic dispersion*. The speed-of-light is slightly different for different wavelengths of light. Although the lasers are nearly monochromatic, they actually put out a narrow range of wavelengths. The different travel times for these components will eventually limit the amount of information that can be transmitted over singlemode fiber.

Fiber Fabrication

Currently, most fiber in North America is manufactured by the Modified Chemical Vapor Deposition (MCVD) process. This process has two major steps:

- Vapor deposition inside glass preform.
- Fiber drawn from collapsed preform.

Once the fiber is spooled and tested, it may be assembled into cables for aerial, buried, or ducted installation. *Refer to Figure 7*

Typical Attenuation Characteristics

This graph of loss vs. wavelength shows why there are certain wavelengths preferred for optical transmission. At visible wavelengths (400–800 nm, off to the left of the chart), silica-based glass exhibits very high loss. The first fiber systems operated near 840 nm, since sources and detectors for that wavelength were readily available. As soon as possible, manufactures began to concentrate on the 1300 nm "window" of exceptionally low loss. Future systems may operate at even higher wavelengths, near 1550 nm. *Refer to Figure 8*

The sharp peak just past 1300 nm is the "hydroxyl peak" – a region of heavy absorption. The curve in *Figure 8* demonstrates low-quality fiber (vintage 1979). Current production fiber controls the peak values more sharply, producing a much smoother curve.

Modified Chemical Vapor Deposition (MCVD)

In modified chemical vapor deposition, several processes combine to create the preform (which is later pulled into fiber). A hollow preform, approximately three feet long and one inch in diameter, spins rapidly on a lathe. A computer controlled mixture of gases is pumped into one end. Underneath, a heat source (such as an oxyacetylene torch) passes back and forth about once per minute.

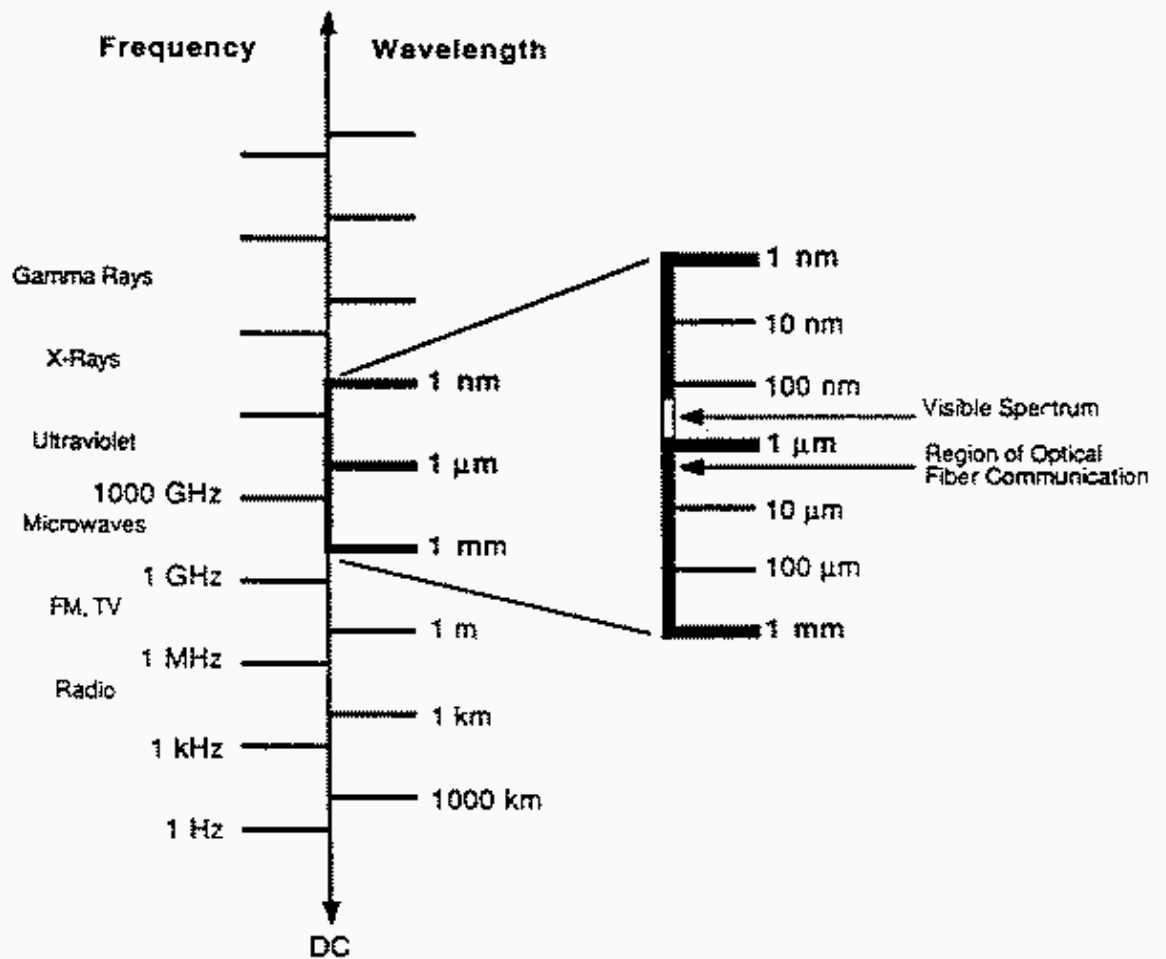
Each passage of the heat source fuses a small amount of the gases to the surface. Most of the gas is vaporized silicon dioxide (glass), but there are carefully controlled amounts of impurities, or dopants. These cause changes in the index of refraction of the glass. As the torch moves and the preform spins, a layer of glass is laid down inside the hollow preform. The dopants (mixture of gases) can be changed with every layer, so the index may be varied across the diameter.

Eventually, enough layers are built up to fill the tube. It is now a scale model of the desired fiber – but much shorter and much thicker. It is now taken to the drawing tower to be pulled into fiber. *Refer to Figure 9*

An Introduction to Fiber Optic Communications

Figure 1

The Electromagnetic Spectrum



An Introduction to Fiber Optic Communications

Figure 2

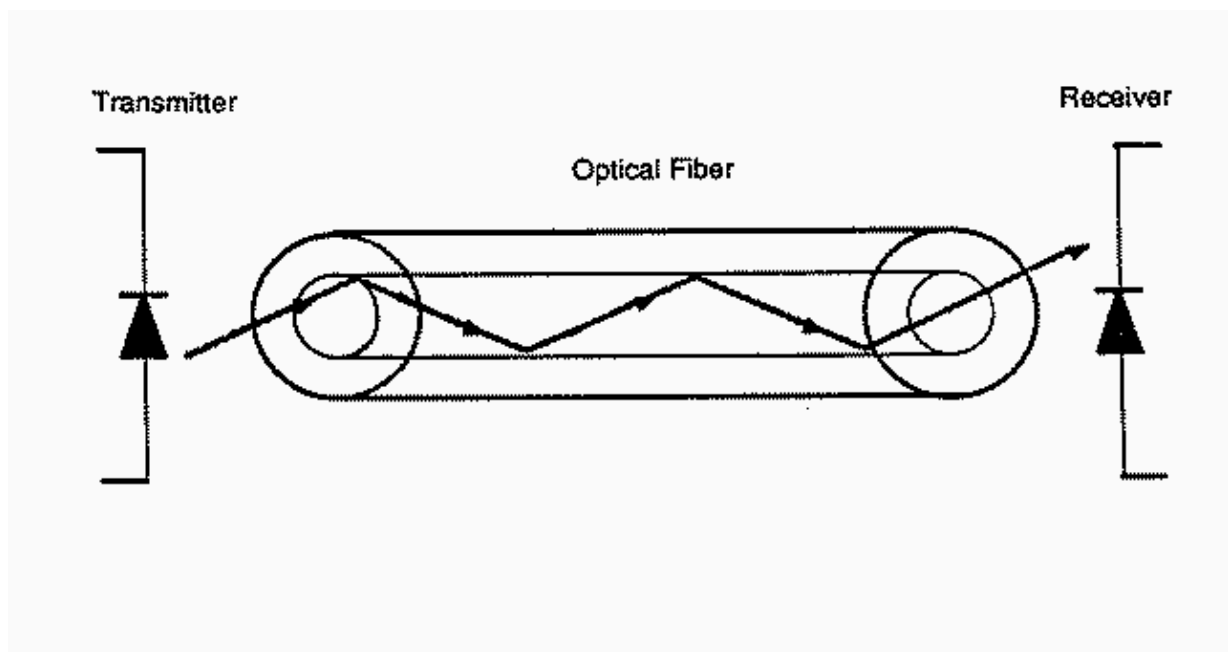
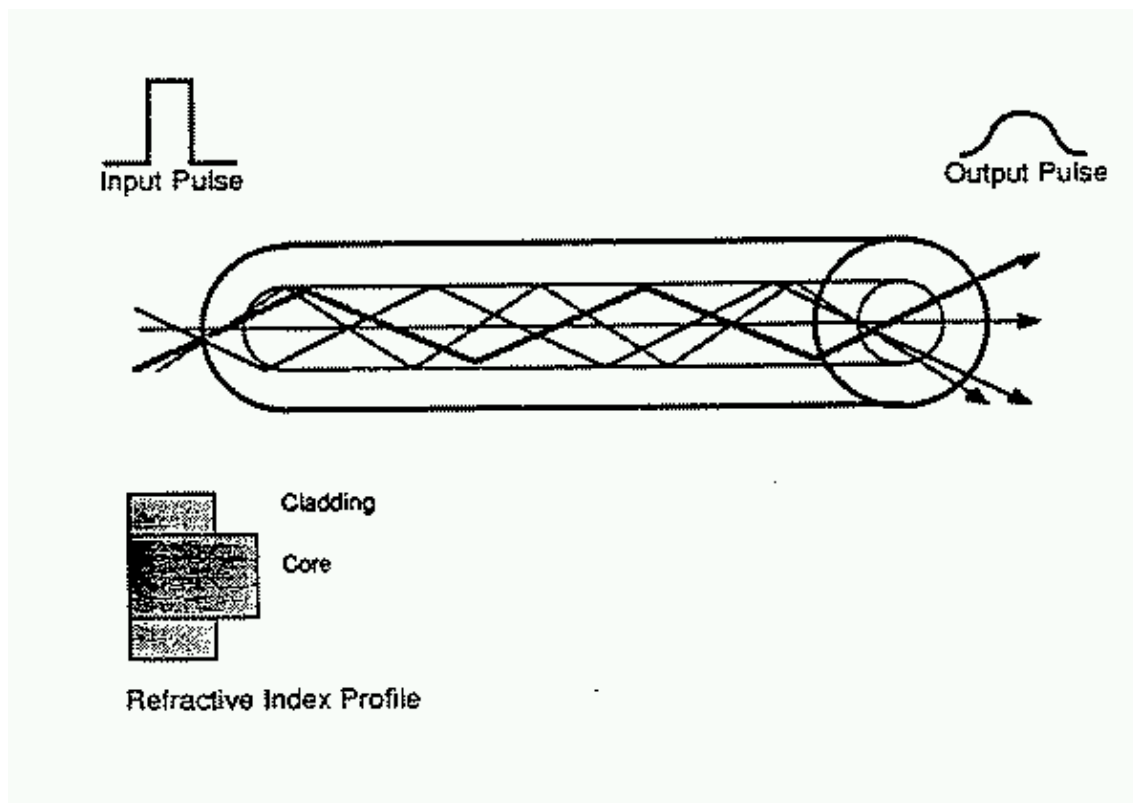


Figure 3



An Introduction to Fiber Optic Communications

Figure 4

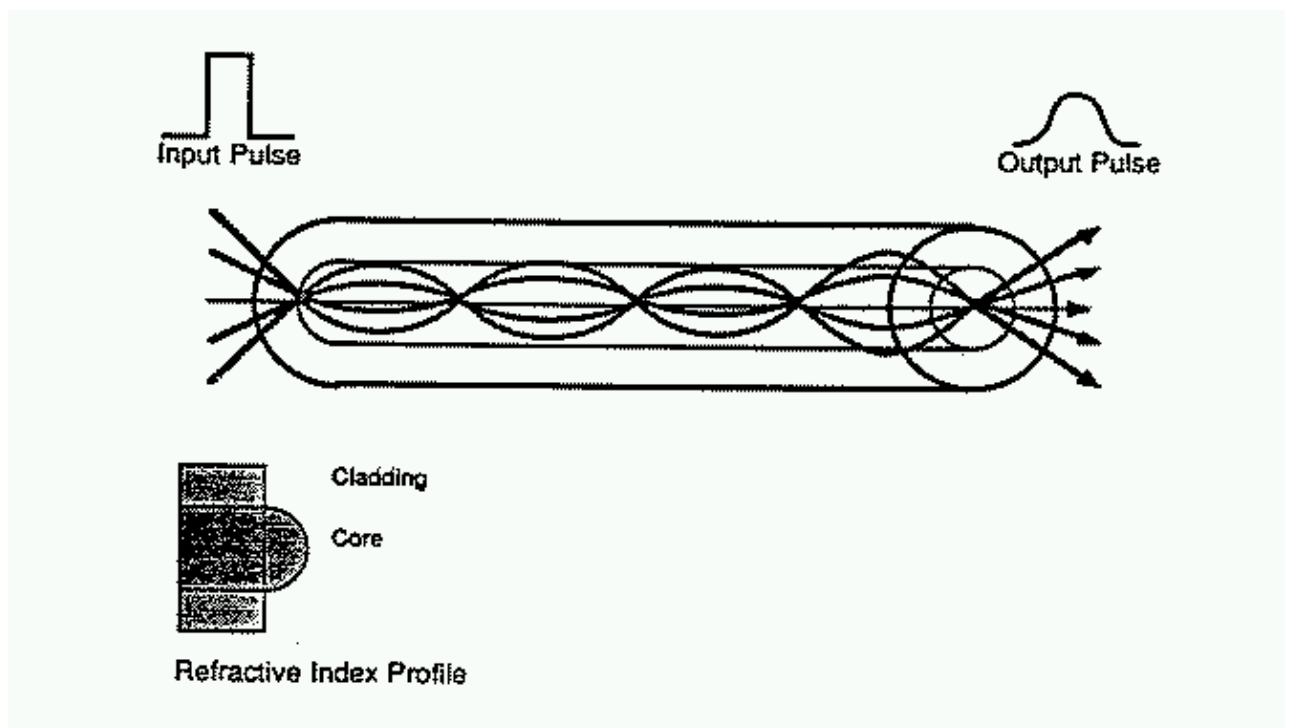
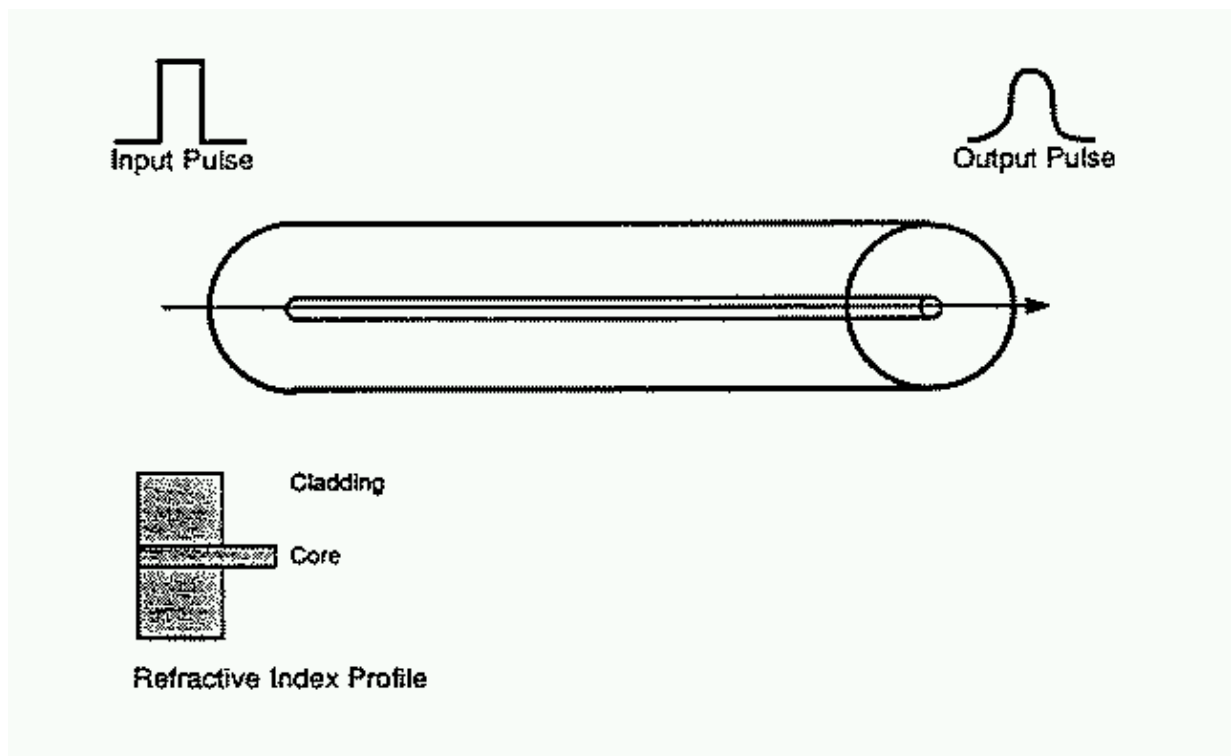


Figure 5

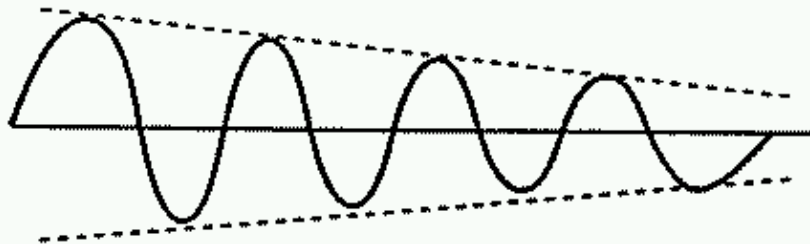


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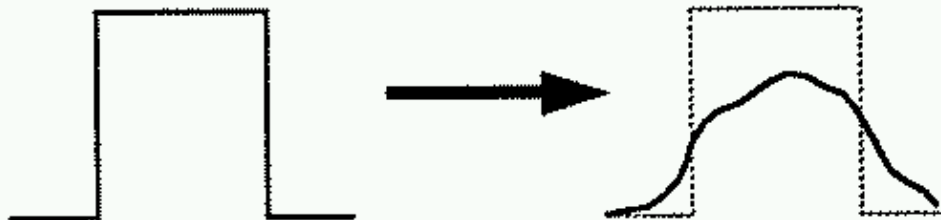
Figure 6

SOURCES OF SIGNAL IMPAIRMENTS

Attenuation
Loss of Signal Power over Distance

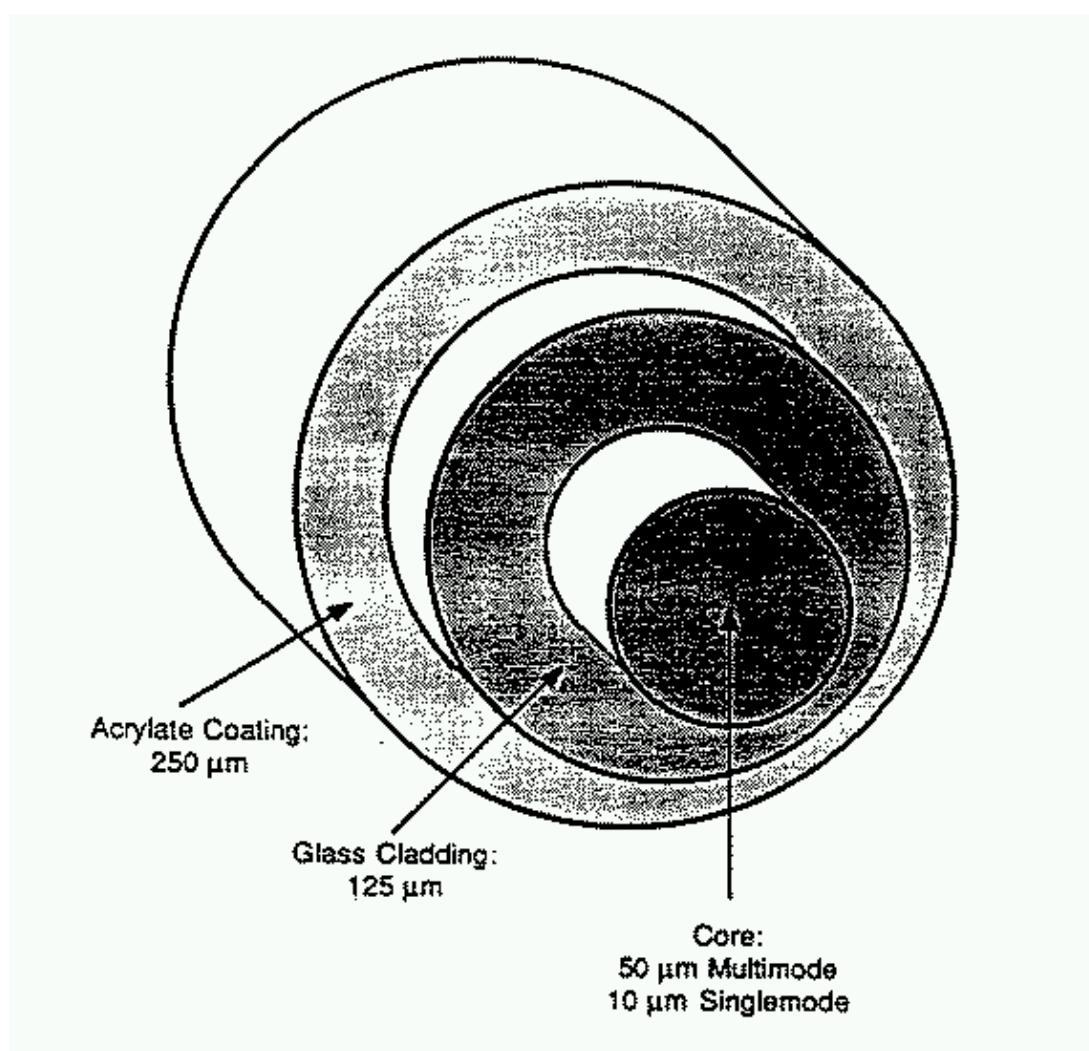


Dispersion
Spreading of Light Pulses with Time



An Introduction to Fiber Optic Communications

Figure 7



An Introduction to Fiber Optic Communications

Figure 8

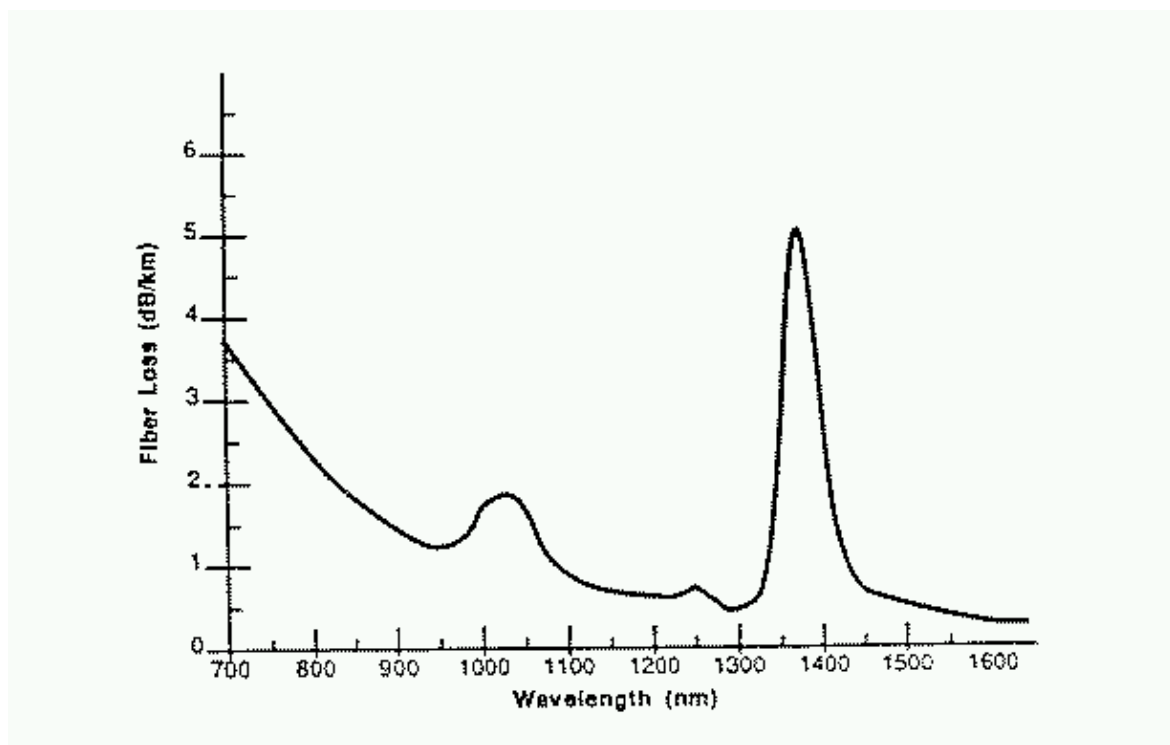
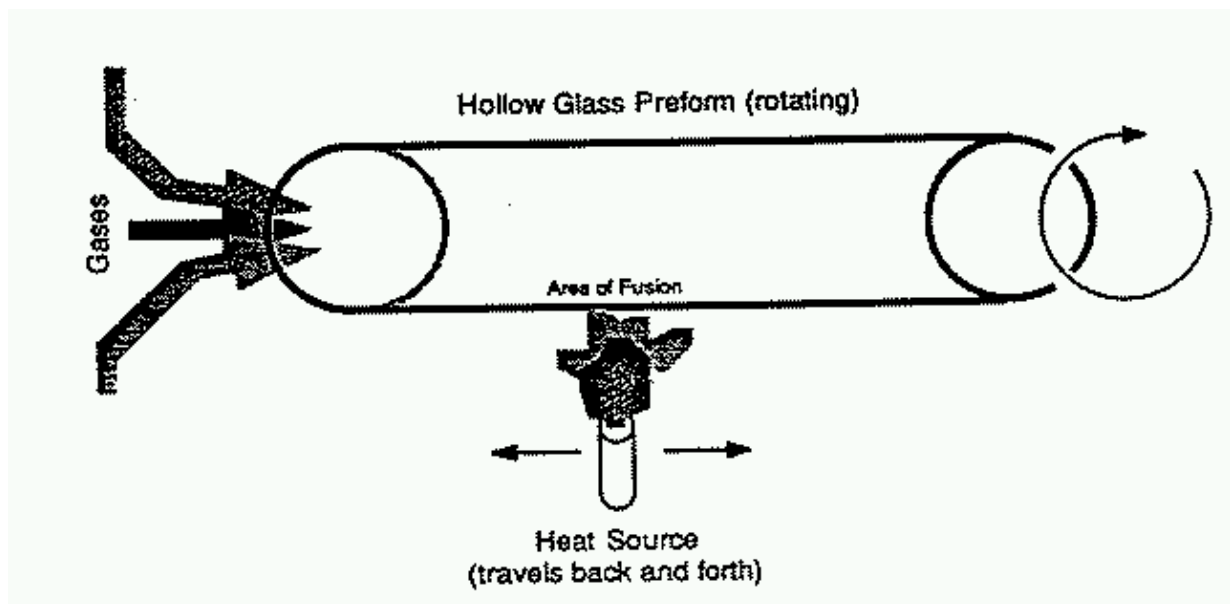


Figure 9



Basic Digital Communication Theory

Digital Transmission

One of the strongest trends in the telecommunications industry in the 1970s and 1980s has been the conversion to digital technology. Transmission equipment, central office switches, Private Branch Exchanges (PBX), and even telephone handsets have benefitted from the digital revolution.

It is a revolution spurred by the semiconductor industry. Functions which formerly took bays of equipment and thousands of dollars may now be accomplished on a single chip, for pennies. As costs have dropped, performance capabilities have soared. Today, digital signal processing techniques that have always had theoretical advantages now have economic advantages as well.

North American Standards

A set of standards for digital transmission have evolved in the United States and Canada. These specify certain parameters for signals of different bit rates (the DS, or Digital Signal, levels). Those most commonly used today include:

Name	Speed (Mbps)	Capacity
DS-1	1.544	24 Voice Channels
DS-1C	3.152	2 x DS-1
DS-2	6.312	4 x DS-1
DS-3	44.736	7 x DS-2

Analog-to-Digital Conversion

Advantages of analog-to-digital conversion: (*Refer to Figure 1*)

- Less susceptible to noise and interference.
- Easier to regenerate the signal if signal repeaters are needed.
- Very accurate reproduction of the original signal, although with the penalty of added bandwidth requirements.
- Allows use of high-speed digital integrated circuits.
- Provides built-in error detection.
- Compatible with digital computer systems.

Nyquist Theorem

A basic rule of digital transmission is known as the Nyquist theorem. It states that in order to reproduce a stream of analog data, such as voice, the digital sampling rate must be at least equal to *twice* the highest frequency in the analog stream.

The human ear is sensitive roughly from 20 Hz to 20 kHz. This would suggest that we needed a sampling rate of: $2 \times 20 \text{ kHz} = 40 \text{ kHz}$. This would have been prohibitively expensive until very recently. However, the human brain is an amazing signal processor. Empirical tests have shown that we can throw away all voice data from 4 kHz to 20 kHz with minimal effect. Although the sound channel is certainly not high-fidelity, it covers the two basic requirements of speech communication: intelligibility (understanding the words said), and recognizability (identifying the voice of the speaker). Therefore, the 4 kHz voice channel has become a standard.

Using the Nyquist theorem, it is easy to see that to reproduce this 4 kHz signal, our sampling rate must be at least: $2 \times 4 \text{ kHz} = 8 \text{ kHz}$. This would be in a theoretically perfect system. However, in practice, transmission systems sample at 8 kHz and allow the voice channel to be slightly less than 4 kHz – 3.2 kHz is typical. (Refer to Figure 2)

Composite Pulse Amplitude Modulation (PAM)

Since the width of an amplitude sample is significantly less than the sampling time, many signals may be interleaved without overlap. In the North American DS–1 signal, 24 sets of 8 kHz data are interleaved before digital conversion. The resultant signal is referred to as "Composite Pulse Amplitude Modulation". (Refer to Figure 3)

Pulse Code Modulation (PCM)

Note that, for clarity, the sample shown displays only 3 bits–per–sample, which produces: $2^3 = 8$ coding levels. Voice–grade systems use 8 bits–per–sample, producing: $2^8 = 256$ coding levels. Digital music systems can use as many as 20 bits–per–sample, resulting in over a million coding levels. (Refer to Figure 4)

Quantization Error

The error in reconstructing a digitized signal is related to the number of bits used in coding the sample. There is a tradeoff between reproduction accuracy and system complexity. (Refer to Figure 5)

A rate of 3 bits–per–sample, as shown in the above example, would be quite simple to implement, but would not produce an understandable voice signal. On the other hand, a rate of 20 bits–per–sample would produce a signal nearly indistinguishable from the original, but would require very sophisticated electronics. Such coding schemes are only economical for high–performance digital audio systems such as Compact Discs (CD). (Note: CD systems also sample far in excess of the 8 kHz discussed here. Most systems currently available use a 44 kHz sampling rate with 18 to 20 bits–per–second.)

For the public digital network, manufacturers have established a standard coding rate of 8 bits–per–sample as a reasonable compromise between cost and fidelity.

DS–1 Frame Format

The above framing format is used by DS–1 equipment to properly identify each time slot and its place in the DS–1 link. A similar, but more complex arrangement of framing bits is used to organize data bits in DS–3 transmission links. (Refer to Figure 6)

Definition of Digital Multiplexer

CCITT Recommendation G.702: A *digital multiplexer* is equipment for combining by time–division–multiplexing two or more tributary digital signals into a single composite digital signal. A *digital demultiplexer* separates the composite signal into its component tributaries. The term *muldex* is a contraction of multiplexer–demultiplexer.

Please note that, although slightly inaccurate, the terms *multiplex* or *multiplexer* are often used to refer to equipment that performs both multiplexing and demultiplexing functions.

Unipolar to Bipolar

Unipolar signals are usually used within a piece of transmission equipment (intra-shelf signaling, etc.) However, for transmission between pieces of equipment (over twisted pair or coax), electrical signals are usually converted to bipolar form.

The bipolar conversion removes the low-frequency components of the signal, removing any average DC voltage. This provides several advantages: (1) line powering of downstream equipment (since the bipolar signal may be "piggybacked" on a DC bias voltage); (2) less power required for transmission; (3) easier to recover clock from the incoming data.

Please note that all optical transmissions are unipolar – since we cannot transmit negative pulses of light. (Refer to Figure 7)

Binary Three-Zero Substitution (B3ZS)

"Straight" bipolar coding is not often used for transmission. When long sequences of zeros are transmitted, downstream equipment can have problems recovering the clock rate from the incoming data. Therefore, various schemes are employed to substitute sets of pulses for long streams of zeros. At the DS-3 rate, B3ZS is employed; at lower rates, less stringent methods are adequate (B6ZS for DS-2 and B8ZS for DS-1). Bipolar violations are used to flag the substitutions. (Refer to Figure 8)

North American Digital Hierarchy

The following rates are those agreed on by major telecommunications manufacturers in the United States and Canada: (Refer to Figure 9)

Carrier	Voice Channels	Number of DS-1s	Number of DS-2s	Number of DS-3s	Total Circuit Bit Rate
Voice Circuit	1	–	–	–	64 kbps
DS-1 Line	24	1	–	–	1.544 Mbps
DS-1C Line	48	2	–	–	3.512 Mbps
FD-2	96	4	1	–	6.312 Mbps
FD-3	672	28	7	1	44.736 Mbps
FD-135	2016	84	21	3	135.510 Mbps
FD-565	8064	336	84	12	570.480 Mbps

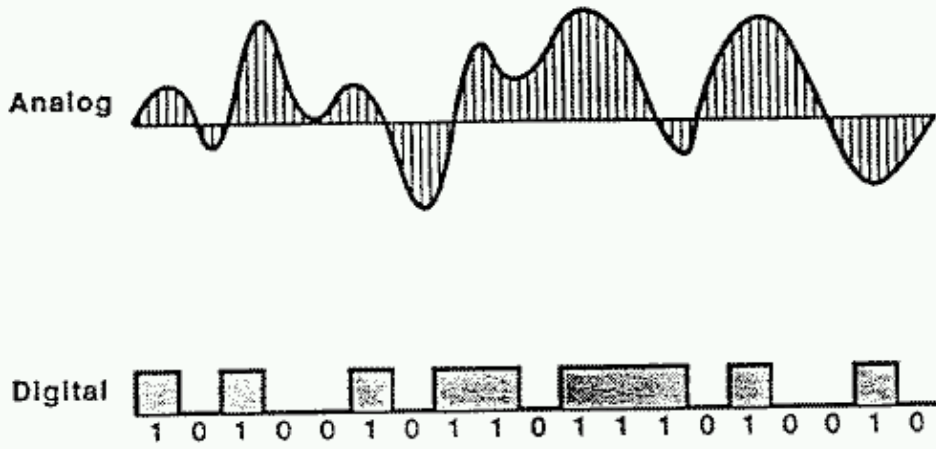
Notes

The DS-1 format is sometimes referred to as the "T-1" format. Bit rates are not direct multiples of lower-level bit rates due to the increased overhead requirements of higher transmission levels.

There is a DS-4 format defined (274.176 Mbps), but this has met with little commercial acceptance. For reference, a DS-4 signal would be the equivalent of two FD-135 channels or half an FD-565 channel.

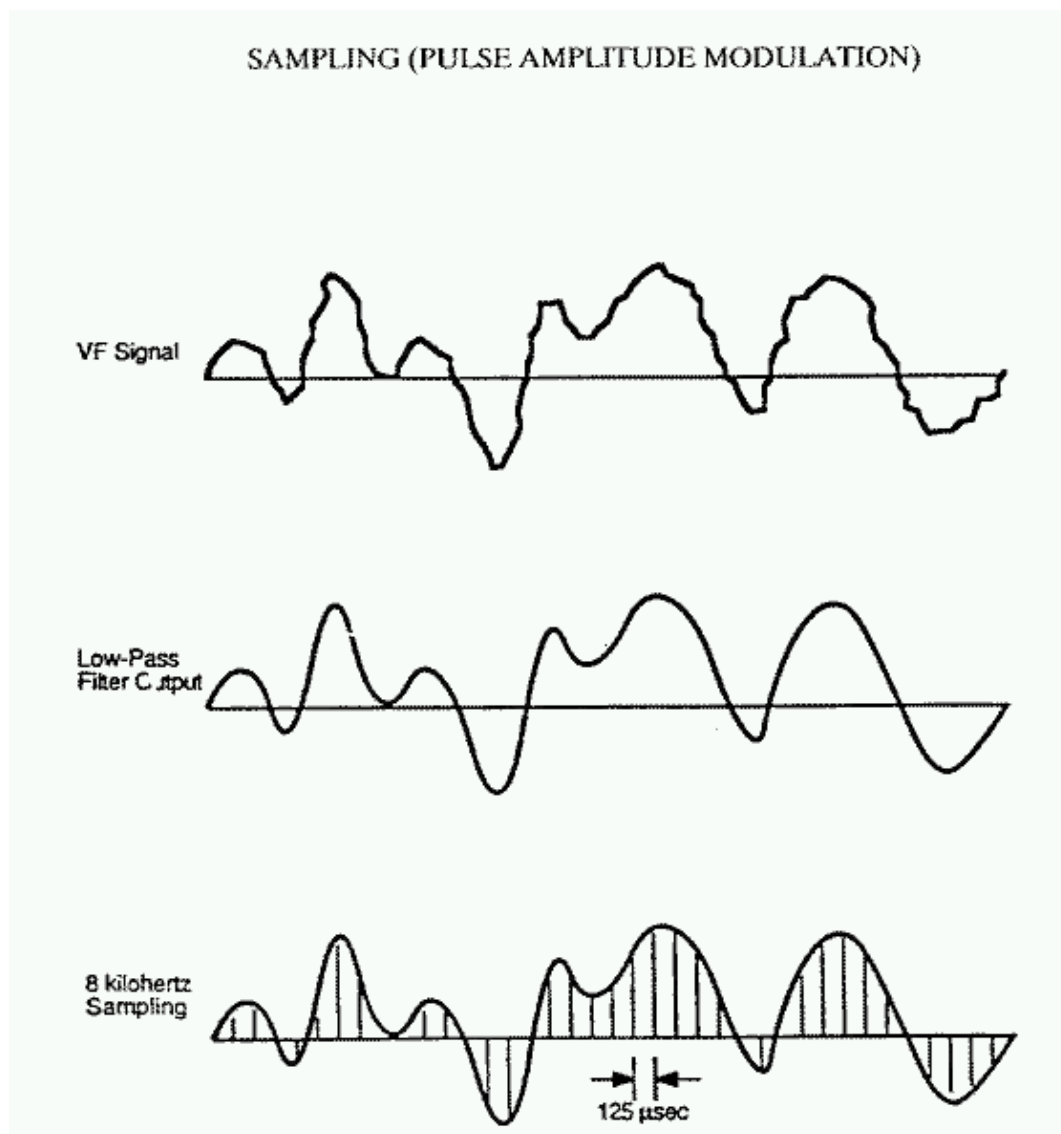
Basic Digital Communication Theory

Figure 1



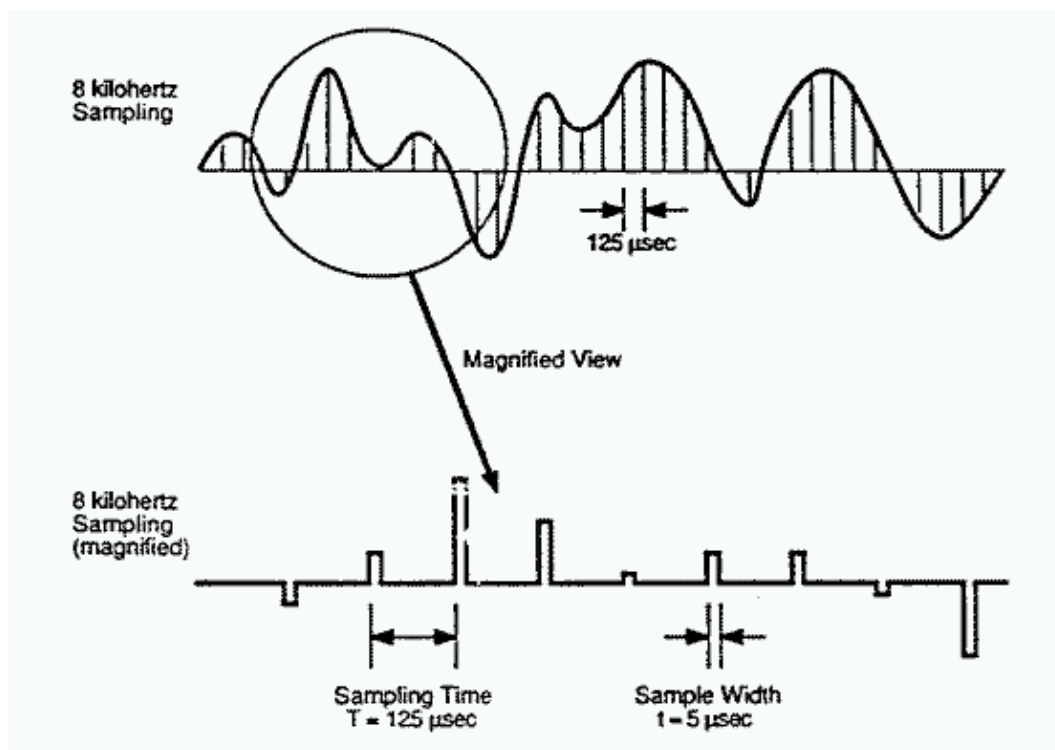
Basic Digital Communication Theory

Figure 2



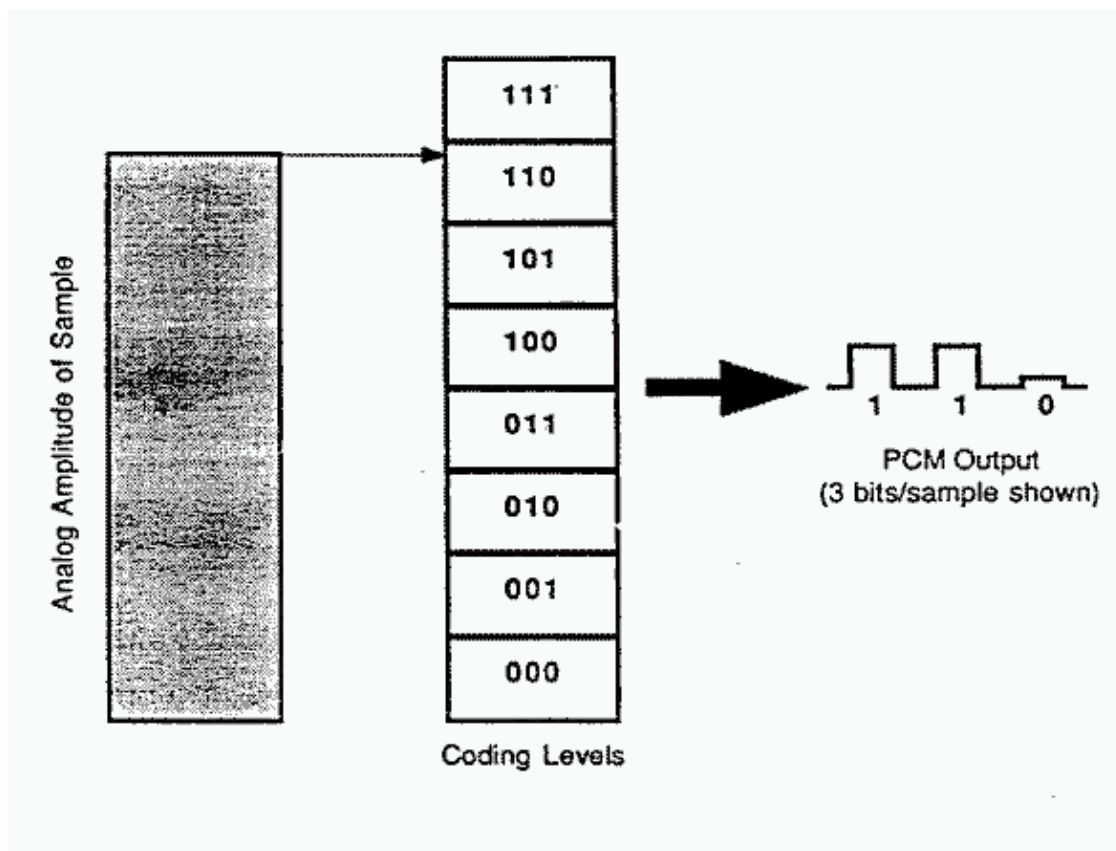
Basic Digital Communication Theory

Figure 3



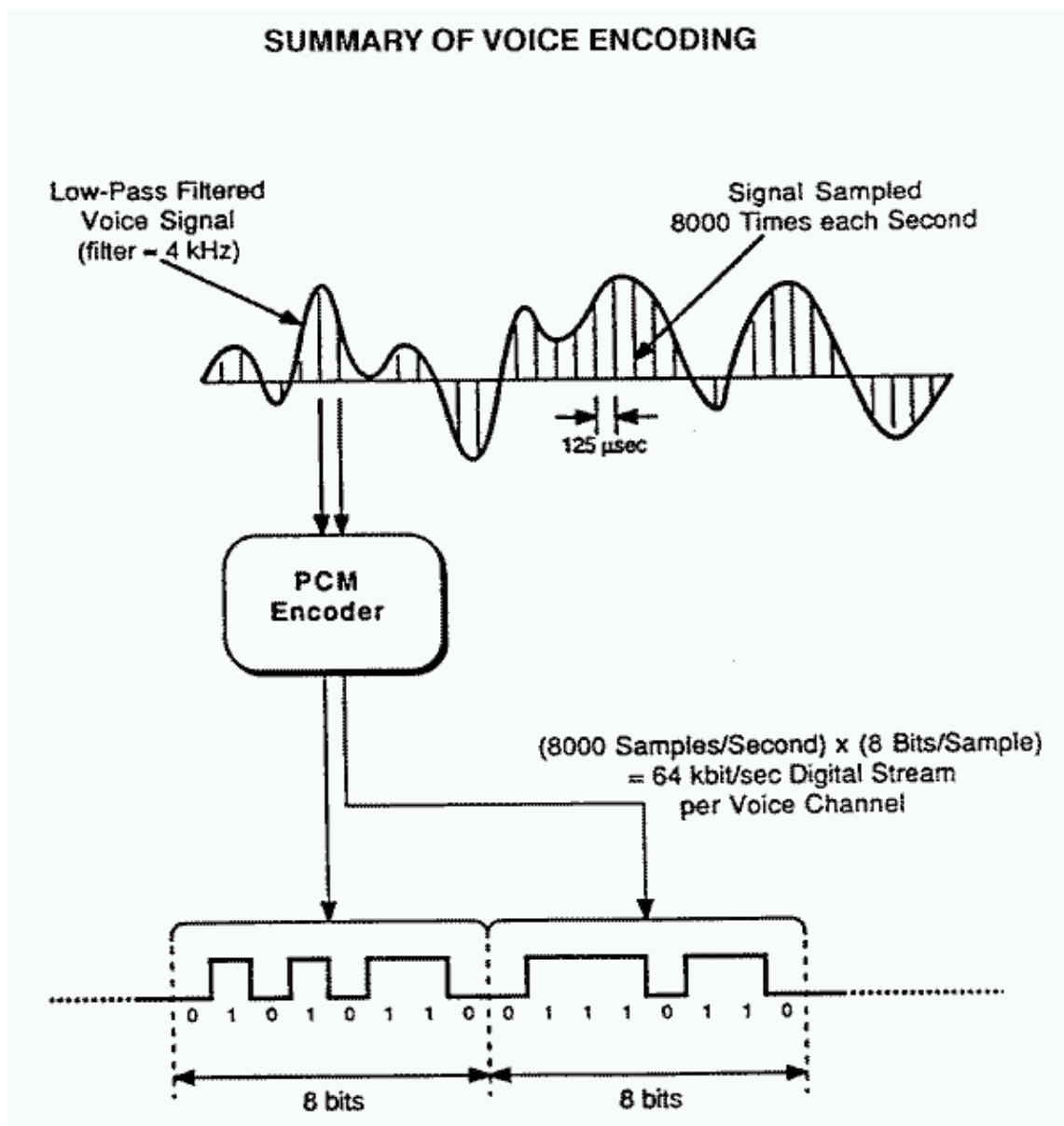
Basic Digital Communication Theory

Figure 4



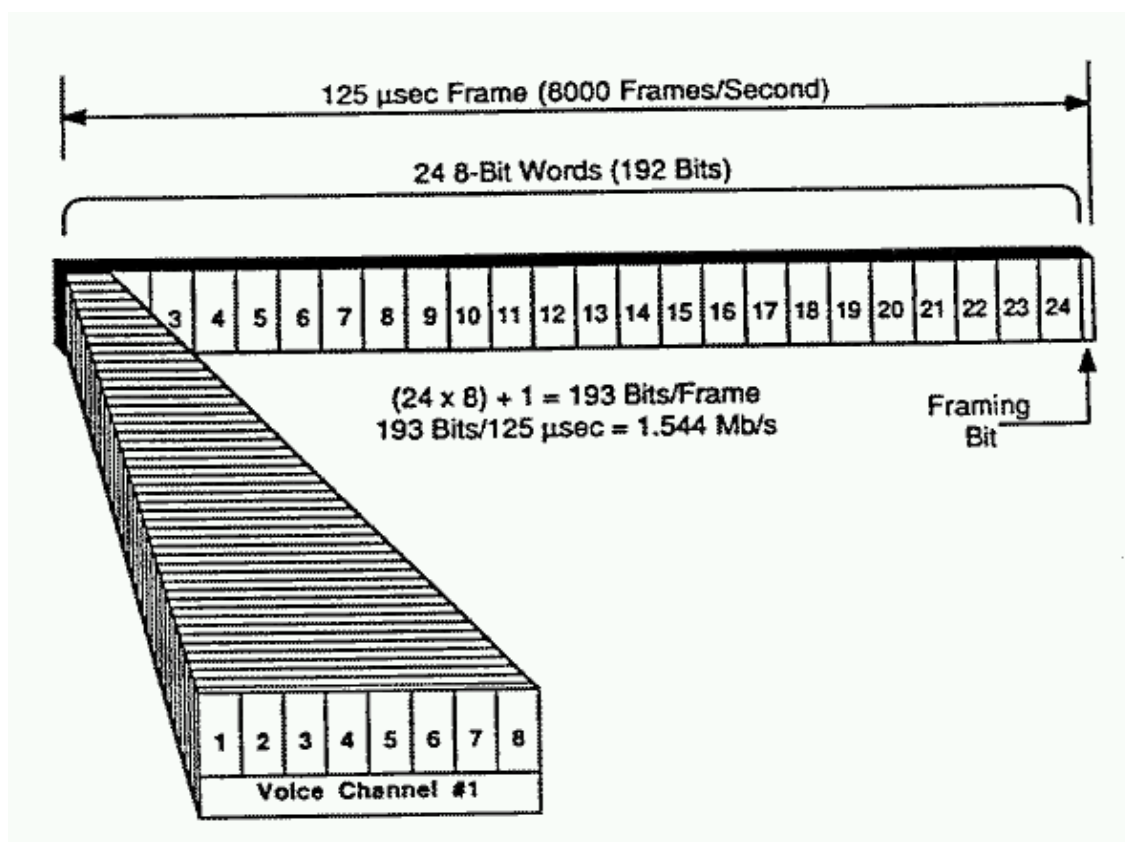
Basic Digital Communication Theory

Figure 5



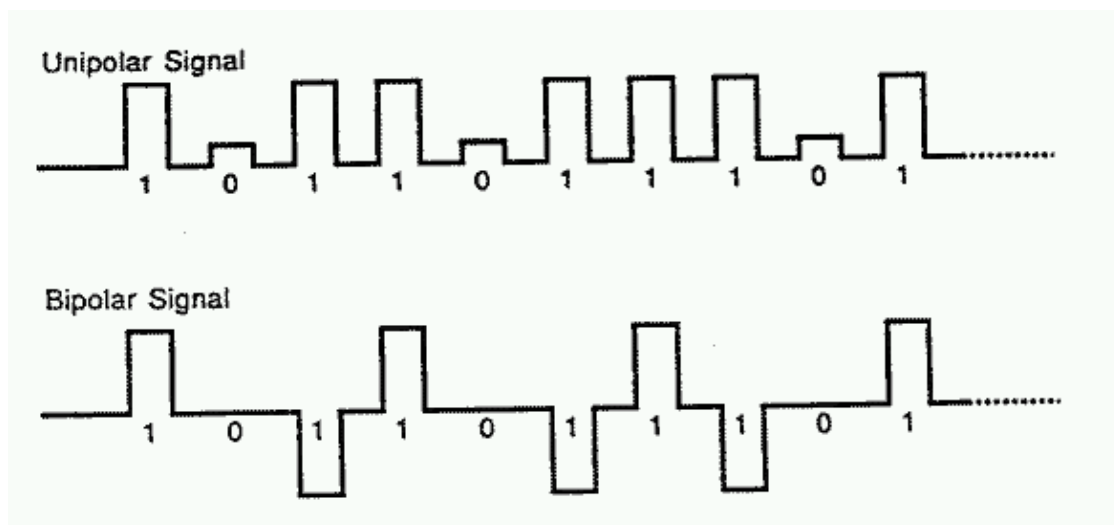
Basic Digital Communication Theory

Figure 6



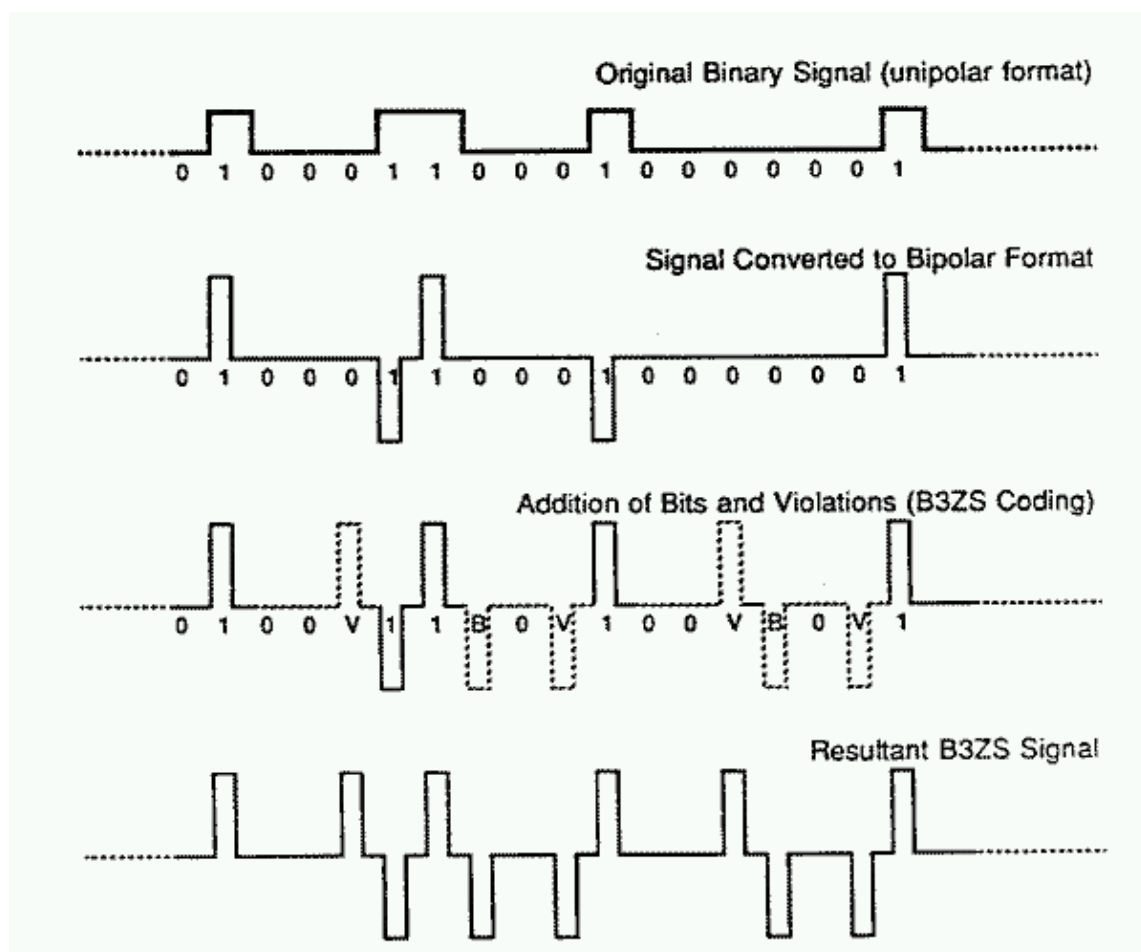
Basic Digital Communication Theory

Figure 7



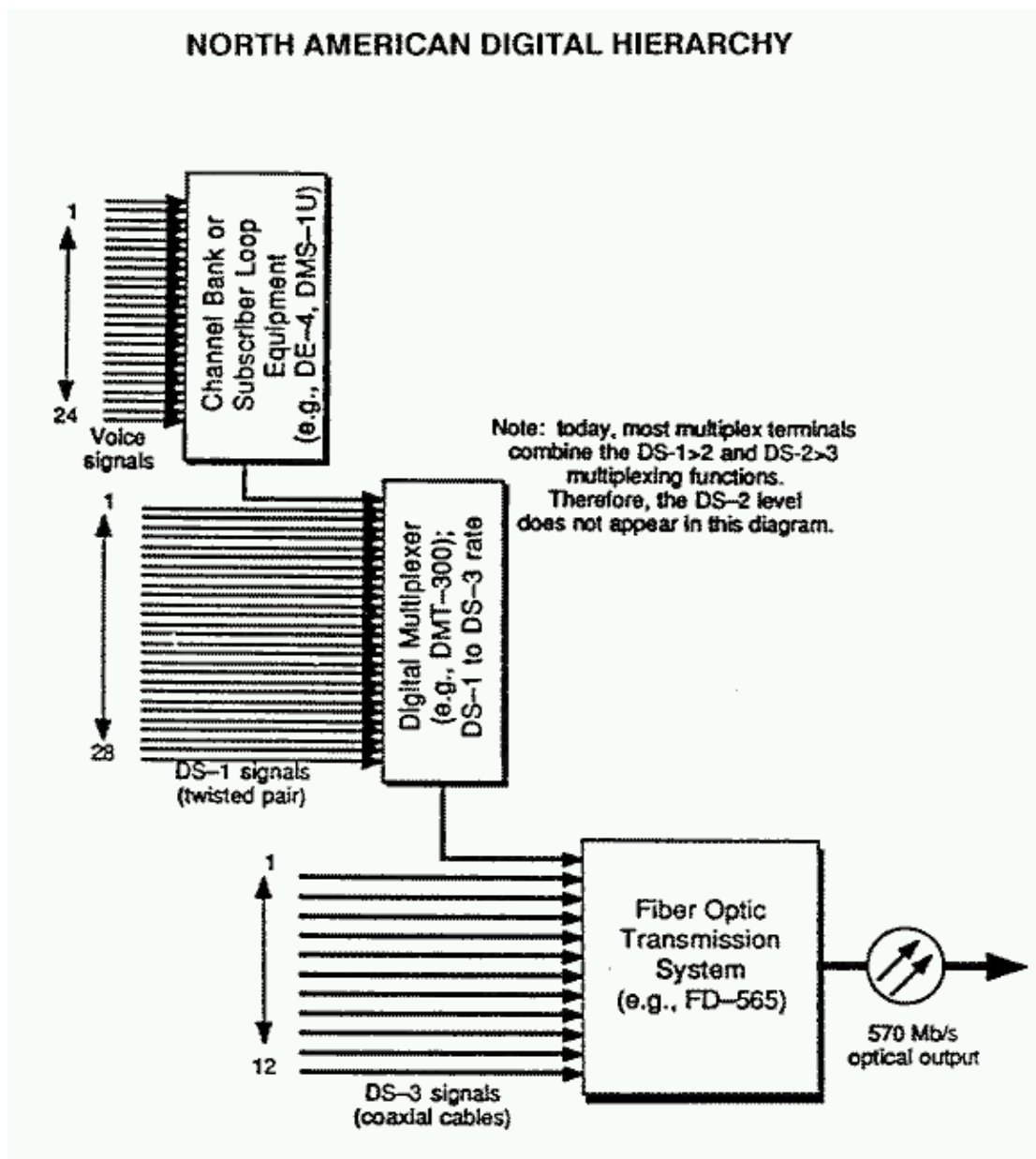
Basic Digital Communication Theory

Figure 8



Basic Digital Communication Theory

Figure 9



Interface with Switching Control Center System / #1 ESS

BELL SYSTEM PRACTICES
AT&T Co SPCS

SECTION 231-190-405
Issue 2, November 1982

FEATURE DOCUMENT INTERFACE WITH SWITCHING CONTROL CENTER SYSTEM FEATURE 2-WIRE NO. 1 ELECTRONIC SWITCHING SYSTEM

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NOTICE

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INTRODUCTION

1. GENERAL INFORMATION

SCOPE

1.01 This document provides information concerning the Interface With Switching Control Center System feature with the No. 1 Electronic Switching System (ESS).

REASON FOR REISSUE

1.02 This document is reissued to provide coverage for the Remote and Central Trunk Test Unit (RTTU/CTTU) feature available with the 1E7 generic program. Revision arrows have been used to denote significant changes.

FEATURE AVAILABILITY

1.03 The Interface With Switching Control Center System feature is available with all active generic programs. The Interface With Switching Control Center System feature is loaded in the generic program base.

1.04 ♦The RTTU/CTTU feature is available with the 1E7 generic program as an optionally loadable feature group.♦

2. DEFINITION/BACKGROUND

DEFINITION

2.01 The Interface With Switching Control Center System feature centralizes operation, administration, and maintenance of telephone switching systems.

BACKGROUND

A. General

2.02 The switching control center (SCC) is a centrally located facility capable of accommodat-

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ing administrative, operational, and maintenance functions for several central offices. Technically, the SCC provides sufficient display, control, and alerting capabilities to enable central office operation to be remotely monitored. Operationally, the primary responsibility for the associated central office resides at the SCC. Work scheduling, dispatching, trouble analysis, and administrative functions are performed at the SCC.

2.03 The centralization concept of the SCC has four primary objectives:

- To improve service quality over an unattended central office operation by economically providing around-the-clock surveillance and control
- To gain manpower efficiency by pooling existing expertise and allowing the pooled force to work on the problems of several offices
- To improve proficiency and training by exposing the SCC force to more switching systems and the associated problems, making it easier for the SCC force to develop and retain skills
- To improve work conditions by providing a pleasant, attractive, and spacious place to work.

By utilizing these concepts, many types of switching machines can be served from the same center.

2.04 Routine teletypewriter (TTY) analysis and office class line call and alarm responses normally reside at the SCC. The actual task assignments are made from the SCC. The central office maintenance personnel use alarm information, TTY printouts, and SCC assistance (as required) to troubleshoot the equipment.

2.05 Two hardware configurations exist to support the SCC: the No. 1 Switching Control Center System (SCCS) and the No. 2 SCCS. The No. 1 SCCS has manual capabilities to provide remote monitoring and control of the central office's TTYs and master control center. The No. 2 SCCS provides remote manual monitoring and control capabilities as in the No. 1 SCCS plus a minicomputer system, including cathode-ray tube (CRT) devices, to collect and analyze central office TTY printouts. These SCCS ver-

sions are compatible, in that growth is available from the No. 1 SCCS to the No. 2 SCCS.

B. ESS/SCC Interface

2.06 There are four basic areas in which the No. 1 ESS central office and the SCC interface. These areas are as follows:

- Telemetry System
- Master control center interface circuitry
- Teletypewriter System
- Remote and Central Trunk Test Unit System interface circuitry.

Telemetry System

2.07 The telemetry system consists of an E2A central at the SCC and an E2A remote at the central office linked together via a 4-wire private line multipoint data network. Control signals and status indications are passed between the SCC and the central office over the E2A Telemetry System.

Master Control Center Interface Circuitry

2.08 Each office in the SCC network must modify the master control center lamp and key circuits to allow telemetry access. The modifications include a master control center interface circuit that allows the SCC to monitor and control the master control center functions, performs safety functions to reduce possible erroneous operations from the SCC, and provides a means of sending additional system indications to the SCC. The safety features consist of interlocks to prevent actions that could cause the system to malfunction, fail-safe timers that disengage control functions if the action is not performed within a specified time limit (30 to 40 seconds), timing circuits to automatically alert the SCC if the ESS is not functioning normally (heartbeat timer), dc isolation to prevent false orders from the telemetry, and an early power release function to be used in the event of a system failure caused by a faulty telemetry facility.

TTY System

2.09 Each No. 1 ESS central office is linked to the SCC location by at least one dedicated TTY

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channel and an extension of the first maintenance TTY channel. Capability exists to extend two additional channels per central office to the SCC: the second maintenance TTY channel and a supplementary trunk test panel TTY channel. The second maintenance TTY channel can have all the capabilities of the first maintenance TTY channel and is the backup for the first maintenance TTY channel in case of its failure. It must be configured for dedicated operation. In addition, through the use of the TTY message TTY-MLTCHAN-, the second maintenance TTY channel can be configured to carry messages of any selected class or classes such as the network or trunk class. In this way, the first maintenance TTY channel can be relieved of excessive printout. The supplementary trunk test panel TTY channel, which has 2-way capability, can be optionally extended to the SCC by dedicated means.

RTTU/CTTU System

2.10 The RTTU/CTTU System consists of the CTTU, which is resident in the SCC, and one or more RTTUs, which reside in the switching office(s) served by the CTTU. Communications between the CTTU and the RTTU and between the CTTU and other Operations Support Systems (OSS) are accomplished via four dialup links (two data links and two voice links) (Fig. 1). One data link is provided between the RTTU frame and the CTTU console. The primary purpose of this data link is to allow the CTTU to control the RTTU. A second data link provided by the system enables the CTTU craft personnel to communicate with other OSSs which include the Centralized Automatic Reporting on Trunks (CAROT) System, and the Trunks Integrated Record Keeping System (TIRKS).

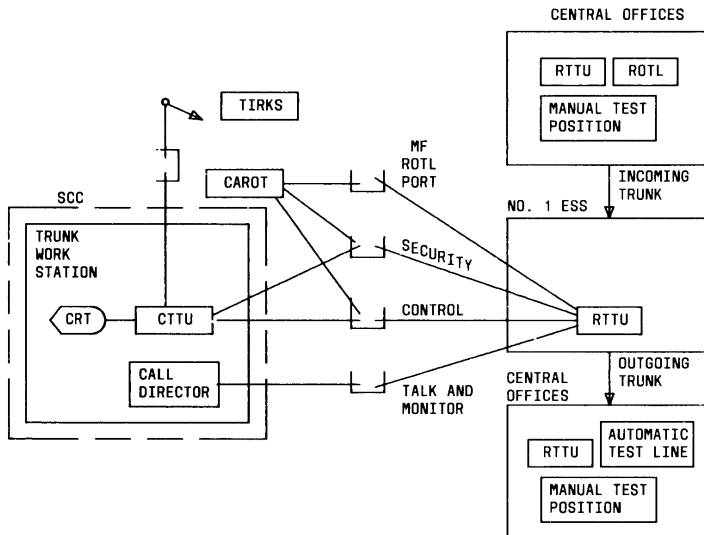


Fig. 1—RTTU/CTTU System Block Diagram

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- 2.11 One dialup voice link extends from the RTTU to the CALL DIRECTOR® telephone at the trunk work station. This link is referred to as the talk and monitor (T&M) path, and it enables the trunk work station craft person to assume the role of a craft person at the RTTU (or near) end of the trunk under test. By using this path, the trunk work station craft person can coordinate testing with a second craft person at the other end of the trunk under test and listen to the progress of test calls.
- 2.12 The second dialup voice link is used for the security callback call from the RTTU to the CTTU.
- 2.13 The CTTU port that is dedicated for OSS interaction requires a 202-type data set while a 212-type data set is contained in the CTTU port used to control the RTTU(s). The T&M path and the security callback link require ordinary loop appearances on the control office serving the SCC.
- 2.14 The CTTU is an intelligent terminal system that contains a processor for overall control, a CRT, a keyboard, a mass-storage device, a local printer and the input/output capabilities necessary to communicate with RTTUs and other OSSs.
- 2.15 The RTTU will respond to commands transmitted to it from the CTTU or CAROT controller (Fig. 1). The RTTU provides the appropriate interface for each switching system and provides the same trunk access, testing, and maintenance state control functions as the on-site trunk test panels to the CTTU craft person.
- 2.16 The remaining RTTU ports are those interfacing to the switching machine. The RTTU has three voiceband ports interfacing to the test access trunks normally associated with a manual test panel. One or more ports serve to support the test line functions. Another incoming port monitors the TTY maintenance channel. A port is also required to interface the master test trunk (MTT) to the RTTU.
- 2.17 The two distinct RTTU interfaces to the No. 1 ESS appear as trunk test panels on the switch and are analogous to the current hardware trunk test panels. The RTTU bridges onto a TTY channel, but does not input TTY messages. The two types of RTTU interfaces are as follows:

- (a) **Manual Trunk Test Panel (MTTP) Interface:** The RTTU can emulate an MTTP in

offices with 1E(B5)5 and later generic programs. This interface is **hardware only** and supports access to 2-wire and HILO trunks, but does not support access to lines. This interface requires optional feature group MTTP.

- (b) **MTTP With Line Testing Interface:** The advantage of this interface is that it includes access to all trunks and lines in the office. The RTTU can provide all the capabilities available at an MTTP plus all the line testing capabilities of the trunk and line test panel (TLTP) in offices with 1E(B7)7 and later generic programs having optional feature groups MTTP and R2C2 loaded.♦

DESCRIPTION

3. USER OPERATION

CUSTOMER

- 3.01 Not applicable.

TELEPHONE COMPANY

- 3.02 Additional displays and capabilities have been provided to simplify operation of a No. 1 ESS office from an SCC. The important master control center control and display functions can be relayed to the SCC via the interface circuitry and telemetry. The additional functions needed are provided by ESS software routines. The software routines monitor important system functions and transmit the system status periodically to the SCC. In addition to system status transmissions, routines have been added to provide TTY control capabilities of several system functions that would have been too expensive to provide to the SCC using hardware.

- 3.03 The following SCC-related software features are available in all active generic programs:

- (a) Master control center lamp test
- (b) System state-of-health indicators
- (c) Central office alarm inhibit mode
- (d) Remote trunk testing via TTY
- (e) Critical indicators
- (f) Additional system status indicators
- (g) SCC lamp test

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- (h) Maintenance TTY status lamps
- (i) Dial tone delay alarm circuit control
- (j) Method of transferring hardware-initiated (fuse) alarms to the SCC
- (k) Central office identification via TTY
- (l) Hard copy TTY printouts
- (m) Emergency action print in a phase
- (n) E2A telemetry failure reporting.

Master Control Center Lamp Test

3.04 The master control center lamp test has been changed to light all of the tested lamps simultaneously for a period of 30 seconds and then turn them off for 6 seconds before returning to the correct state. The previous method of winking each lamp four times in succession proved to be unnecessarily confusing to follow and took too long. Besides correcting these problems with the master control center lamp test, the new method of testing the lamps simultaneously conforms with other SCC lamp tests. The SCC can use the master control center lamp test to detect faults in the SCC console status lamps, the master control center interface circuitry, and the telemetry link. The master control center lamp test is still initiated via the TTY input message MCC-DGN-0 and can be aborted by using the MCC-DGN-1 message.

System State-of-Health Indicators

3.05 The system state-of-health indicators provide real-time system status information and an indication of the system's call processing ability. This feature includes six indications using signal distributor points to display the entire base level cycles (E-to-E) rate, line service request hopper unloading rate, jobs omitted because of overload, and three call processing queues that are active. These indicators consist of 26 lamps located on the SCC console.

3.06 An administrative routine, much like the master control center lamp administration routines, is entered every 2 seconds on base level. Call store flag words are interrogated, and each bit found set is interpreted as a request to operate a signal distributor point associated with the corresponding in-

dicator lamp on the SCC console. Before changing the signal distributor points requested, a check of points already operated is made and compared with the operate requests. The differences between what is operated and what was requested to be operated cause the routine to set or reset the signal distributor points to the same state as reflected in the flag words. Then the states are stored for the next routine entry.

3.07 An emergency action phase 4 or higher causes all of the system state-of-health indicators to be reset and then returned to the proper indication immediately after the phase. This is caused by the phase zeroing the flag words. Since the program has no idea what the states of its signal distributor points are after a phase 4 or higher interrupt, the routine that releases all of the points is called. After the phase, the requests placed in the flag words are honored to update the system indicator lamps.

3.08 The system state-of-health indicator lamps are located on the SCC console and are updated by the telemetry every second only if the console is in operation.

3.09 These indicators provide additional information only for the SCC operator to determine if an office is functioning properly. These indicators are not intended as triggers for the SCC operator to take any manual corrective action but are to be used for evaluating problems a system may be experiencing. The system itself detects serious problems and takes automatic corrective action when required.

3.10 The system state-of-health indicators, as they are indicated on the SCC console and as they are referred to in the call store flag words, are as follows:

(a) **E-to-E Rate:** Eight lamps display the average number of E-to-E cycles that will be completed in 15 minutes at the present rate. This value is computed every 2 seconds, and the display is updated to the current value if it has changed. The E-to-E rate of the system is regarded as an indication of system load. A low rate of E-to-E alone should not trigger the SCC operator to take corrective action.

(b) **Line Service Request Hopper Unloading Rate:** Three lamps (MAX, MID, MIN) display the rate at which the line service request hopper is unloaded. This rate normally can vary

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from a nonzero minimum to a maximum by 16 steps. The first lamp, labeled MAX, is lit when the unloading rate is at its maximum value. This corresponds to a low traffic condition. The third lamp, labeled MIN, is lit when the unloading rate is at its minimum nonzero value. The second lamp, labeled MID, is lit whenever the unloading rate falls between the maximum and minimum values. If the E-to-E time (average over the last three E-to-E times) as computed by the system exceeds 1.0 second but is less than 1.8 seconds, the unloading rate will be decreased by one step. The unloading rate is decremented once every 3 seconds as long as the E-to-E time exceeds 1.0 second until the minimum rate is reached. If E-to-E time is less than 1.0 second, the unloading rate is increased by one step every 5 seconds until the maximum rate is reached. Average E-to-E times in the range of 1.0 through 1.8 seconds, resulting in a hopper unloading rate of less than maximum, define minor central control overload. If average E-to-E time exceeds 1.8 seconds, the system enters major central control overload. During major central control overload, the unloading of the hopper is suspended (unloading rate of zero) and, in this case, none of these three lamps will be lit. The unloading rate is set to some middle value after most corrective actions, such as a phase or interrupt.

(c) **Jobs Omitted Due to Overload:** When the ESS gives an indication that it is becoming overloaded, either because of a heavy traffic condition or possibly some trouble condition, several actions are taken in an effort to reduce the time taken by nonessential jobs. Restore verify (RVFY) test and false cross and ground (FCG) test, normally made on each call, are omitted when there is a heavy real-time load on the system, as indicated by an E-to-E cycle time not quite at the minor central control overload point. If the system encounters a trunk group with no idle trunks during a trunk hunt, the call is blocked. Normally, the system hunts for a trunk in another group when a blocked condition is encountered. The second hunt is called a blocked retry (BLK RTY). Block retries for trunk hunts are not done when the system is in major central control overload.

(d) **Transmitter Queues Active:** Once every 60 seconds the data validation routine checks the integrity of various service circuits. Transmitter service circuits checked are the multifrequency (MF), the trunk dial pulse (TDP), and the revertive

pulse (RP) service circuits. If all service circuits of a given type are marked busy at the time of the check, the corresponding lamp is lit.

(e) **Register Queues Active:** Once every 60 seconds a check is made by the data validation routine on the integrity of the following registers: originating, ringing, automatic message accounting (AMA), and disconnect. If it is found that no registers of a given type are idle or that the queue bit was set for that register, the corresponding lamp is lit.

(f) **Receiver Queues Active:** A check is made every 2 seconds on the queue activity bits for the following receivers to see if the queues are active: customer TOUCH-TONE® dialing, customer dial pulse (CDP), MF, RP, and TDP. If any of these queues are found active at this time, the corresponding lamp is lit.

Central Office Alarm Inhibit Mode

3.11 The Central Office Alarm Inhibit Mode feature is initiated by the TTY input message ALRM-CONFIG-OFC INH.

3.12 When an office is being controlled by the SCC, an alarm mode is required that consists of suppressing the central office audible alarms and momentarily turning on the appropriate alarm lamp. The audible alarms are not needed in the central office when it is unattended and may be annoying to persons who are working elsewhere in the same building. The spurt of the alarm lamp is needed to pass the alarm indication to the SCC location, where corrective action can be taken. When an alarm occurs, a lamp lights and an audible alarm at the SCC sounds continuously for major or critical alarms (spurt for minor alarms) until corrective measures are taken by the SCC to retire it. This alarm mode is controlled via TTY. To initiate this mode of operation, the TTY input message ALRM-CONFIG-OFCINH is typed at a maintenance TTY channel. This function is stopped either by typing ALRM-CONFIG-OFC NOR or by an emergency action phase 4 or higher. This alarm mode is allowed only in an office equipped for SCC operations.

Remote Trunk Testing Via TTY

3.13 Trunk testing via TTY allows a remote location SCC to accomplish the following:

(a) Make a single trunk busy.

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- (b) Make a single trunk idle.
- (c) Diagnose a single trunk.
- (d) Diagnose entire trunk out-of-service (TOS) list.
- (e) Make entire trunk group busy.
- (f) Print all trunks in specified trunk group.
- (g) Print message trunk (incoming, outgoing, and 2-way) out-of-service list in order of trunk group number.
- (h) Perform remote office test line (ROTL) interrogator functions including a transmission measurement with signaling.
- (i) Determine busy status of a trunk.
- (j) Apply ac open, ac short, balance and milliwatt terminations to a trunk.
- (k) Traffic release a trunk connection.
- (l) Trace and hold a connection involving a trunk.
- (m) Report the state of E&M leads and change the state of the M lead.
- (n) Perform a voice communications test on a single trunk via central office talk and monitor circuit.
- (o) Perform a measurement test on a single trunk via remote dc voltmeter.

Critical Indicators

3.14 The critical indicators provide a means of obtaining real-time information concerning the status of an office without having an SCC console connected to the office. Twenty indicators are displayed on a wall panel at the SCC (one display panel per office). Four of these critical indicators are driven from the SCC location. Seven of the indicators are hardware driven from the ESS offices. (Important master control center status lamp indications are summarized and sent to the critical indicator panel via the master control center interface circuitry.) The hardware-generated critical indicators are not dependent upon the generic program. Seven criti-

cal indicators are controlled by both hardware and software. The remaining two critical indicators are controlled by software routines that monitor important system functions. The software-controlled indications are updated routinely once per second.

3.15 All critical indicators from the central office are scanned by the telemetry unit each second and sent to the SCC critical indicator panel. The critical indicators and their derivations are as follows:

- (a) **ON-LINE:** The SCC has input TTY capability to the central office. Indication is supplied by the SCC TTY switching apparatus.
- (b) **AUD OFF:** The SCC has silenced the SCC audible alarms for the central office. Indication is supplied by the SCC alarm circuitry.
- (c) **TELEM:** A telemetry failure has been detected. Indication is supplied by the E2A Telemetry System.
- (d) **MESSAGE:** Not presently used.
- (e) **CRIT:** A critical alarm condition exists at the central office, or the heartbeat timer has timed out. For the No. 1 SCCS, the master control center interface circuitry transfers the indication to the SCC via the telemetry unit. For the No. 2 SCCS, the alarm indication is transferred to the SCC by both the telemetry unit and the TTY.
- (f) **MAJOR:** A major alarm condition exists at the central office. For No. 1 SCCS, the master control center interface circuitry transfers the indication to the SCC via the telemetry, or in the case of hardware-generated (fuse) alarms, the indication is generated by the alarm administration programs. For the No. 2 SCCS, the software alarm indication is transferred to the SCC by both the telemetry unit and the TTY.
- (g) **MINOR:** A minor alarm condition exists at the central office. For the No. 1 SCCS, the master control center interface circuitry transfers the indication to the SCC via the telemetry, or in the case of hardware-generated (power room failure) alarms, the indication is generated by the alarm administration programs. For the No. 2 SCCS, the software alarm indication is transferred to the SCC by both the telemetry unit and the TTY.
- (h) **SYS EMER:** An emergency action phase or repeated time-out has occurred. The master

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control center interface circuitry scans the EA PHASE IN PROGRESS lamp, the REPEATED TIME-OUT lamp, and the DT DEL ALM (Vaughan box alarm). If one of these lamps is on, an indication is sent to the SCC via the telemetry. In addition, if the heartbeat timer has timed out, this indication is sent to the SCC.

(i) **CC:** One or both central controls are out of service. The master control center interface circuit scans the central control trouble and power lamps. If a trouble lamp is on or if a power lamp is off, this indication is sent to the SCC via the telemetry.

(j) **SP:** One or both signal processors are out of service. The master control center interface circuit scans the signal processor trouble lamps; if any one of the lamps is lit, this indication is sent to the SCC via the telemetry.

(k) **PS:** One or more program stores or a program store bus is out of service. The master control center interface circuit scans the program store trouble lamps and the software indicators for a program store bus trouble. If a trouble is indicated, this indication is sent to the SCC via the telemetry.

(l) **CS:** One or more call stores or a call store bus is out of service. The master control center interface circuit scans the signal processor and central control call store primary and secondary trouble lamps and scans the software indicators for a call store bus trouble. If a trouble is indicated, this indication is sent to the SCC via the telemetry.

(m) **PERIPH A:** A trouble has been detected in a group of hardware units designated peripheral group A. This group consists of:

- (1) Master scanners
- (2) Central pulse distributors
- (3) Ring and tone plants
- (4) First and second maintenance TTYs
- (5) 1A timers
- (6) AMA equipment
- (7) Automatic identified outward dialing receivers

- (8) Peripheral unit bus
- (9) Central pulse distributor bus
- (10) Scanner answer bus.

Note: The master control center interface circuitry performs a logical "OR" between the master control center trouble lamps of the units and the software indicators for trouble on the buses. If a trouble exists, an indication is sent to the SCC via the telemetry.

(n) **PERIPH B:** A trouble has been detected in a group of hardware units designated peripheral group B. This group consists of:

- (1) Line switch frames/circuits
- (2) Junctor switch frames/circuits
- (3) Trunk switch frames/circuits
- (4) Junctor frames
- (5) Trunk frames
- (6) Recorded announcement frame
- (7) Centrex data link frame
- (8) Common channel interoffice signaling data terminal frames.

Note: The master control center interface circuitry performs a logical "OR" between the master control center trouble lamps of the units and the software indicators for the recorded announcement and data link frames. If a trouble exists, an indication is sent to the SCC via the telemetry.

(o) **BLDG INH:** A central office building alarm has been inhibited. The central office provides an input to the master control center interface circuitry when a building alarm is switched off.

(p) **BLDG/PWR:** A central office building alarm has been detected. The 32 building alarms selected as the most important in the major building alarm scan point matrix and the power alarm scan points (commercial power, battery, and major or minor power) are scanned by

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the alarm administration programs. If a point is found that indicates an alarm condition exists, an order is sent to the SCC via the telemetry to light the appropriate lamp.

Note: The fire alarm is wired to the first scan point in the major building alarm scan matrix. A fire alarm lights a critical lamp and sounds a critical alarm at the SCC.

(q) **FORCED:** The master control center configuration has been forced off normal, or an A through F interrupt key or a program control key has been operated. This indication is set by the master control center interface circuitry for all conditions that signify the master control center is forced off normal. The SCC administration routines check the interrupt control keys (A through F and enable) and the program control keys (BB17 keys). If any of these keys are operated or if the master control center is off normal, this indication is sent to the SCC via the telemetry.

(r) **TRAFFIC:** A significant traffic condition exists or the system cycle time has become excessive. If the SCC administration program detects any of the following conditions, the indication is sent to the SCC via the telemetry:

- (1) Central control overload (minor or major)
- (2) Three successive dial tone delays
- (3) Line load control active
- (4) Outgoing load control active
- (5) Incoming load control active.

(s) **UNLABELED (GREEN):** The system appears to be operating normally. This indication should always be present unless one of the following conditions exists.

- (1) Either a manual or system requested diagnostic is in progress.
- (2) A dial tone delay alarm has occurred.
- (3) A significant traffic condition exists.
- (4) The system is not cycling properly (heartbeat timer time-out).
- (5) Central control trouble (one or both).

- (6) Program store trouble (one or more).
 - (7) Signal processor trouble (one or both).
 - (8) Call store trouble (primary).
 - (9) Emergency action or repeated time-out.
 - (10) Primary faults on any of these peripheral units: line switch, trunk switch, junctor switch, trunks, junctors, master scanner, central pulse distributor, ring and tone plants, common channel interoffice signaling data terminals.
- (t) **CKT LIM:** A data validation protected service circuit trunk group has overflowed in the last 15 minutes and has more circuits out-of-service than the automatic maintenance limit allows. This critical indicator relates the same information as the trunk maintenance busy overflow lamp on the master control center.

3.16 An emergency action, phase 4 or higher, causes all of the software-controlled critical indicators to be reset and then returned to the proper indication immediately after the phase. This is caused by the phase zeroing the critical indicator control words. Since the control words are zero, the critical indicator lamp administration routine resets all of the lamps that are on and returns the lamps to the proper indication when the control words are updated.

3.17 These indicators provide a summary of the machine's functional capability. The critical indicators, in most cases, will be a signal to the SCC operator that an office is experiencing trouble that should be analyzed and possibly an indication for some means of manual corrective intervention.

Additional System Status Indicators

3.18 In addition to the system state-of-health display indicators mentioned in paragraphs 3.05 through 3.10, four additional indicators are used to aid in the maintenance of a No. 1 ESS office. These indicators appear on the SCC console and are to inform the SCC personnel of abnormal conditions that exist at the office. The additional indicators are as follows:

- (a) **Commercial Power Alarm:** There has been a commercial power failure and the office is running on auxiliary power.

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(b) **Central Office Alarms Inhibited:** This lamp is on when the silent alarm mode is in operation.

(c) **Dial Tone Delay Alarm (Vaughan Box):** A dial tone delay has been detected by the dial tone delay alarm (DTDA) circuit, and the DTDA circuit alarm is sounding in the central office.

(d) **System Cycling Indicator:** This indicator should normally be on to indicate that the No. 1 ESS processor is cycling regularly. (Routine main program entries are being completed successfully.)

SCC Lamp Test

3.19 The SCC display lamps can be tested at the SCC by two methods. The first method is hardwired in the console, and the test is initiated by depressing the local lamp test key on the console. This method checks only the lamps on the console; therefore, an additional method to check the lamps and the circuitry involved was designed. The second method is initiated at the same time as the master control center lamp test.

3.20 When the master control center lamp test is initiated, all of the lamps added for SCC operation (system indicators, critical indicators, and some additional indicators) are lighted simultaneously with the lamps that are lit for the master control center test for a period of 30 seconds, then turned off for 6 seconds before being returned to the proper state.

Maintenance TTY Status Lamps

3.21 The ESS lamp administration program turns on the respective lamp when a maintenance TTY channel (first or second) is out of service.

Dial Tone Delay Circuit Control

3.22 Since the audible alarms at the central office are not needed when the SCC is controlling the office, a means of retiring the DTDA is needed. The DTDA circuit was modified to permit the retiring of the alarm, resetting of the circuit, and disabling of the alarm via program control. The DTDA control is initiated via the ALRM-CONFIG-DTD TTY message.

3.23 Once an alarm is received from the DTDA circuit (DTDA lamp), the SCC personnel can re-

tire the alarm and reset the circuit via an ALRM-CONFIG-DTD RTR TTY message. If the problem persists, an ALRM-CONFIG-DTD INH message can be used to shut off the DTDA circuit until the cause can be resolved and fixed. Once the problem is resolved, the circuit can be restored to normal by using an ALRM-CONFIG-DTD-NOR message.

Method of Transferring Hardware-Initiated (Fuse) Alarms to the SCC

3.24 The occurrence of a hardware alarm is detected by the ESS alarm administration programs and the alarm indication is sent to the SCC.

Central Office Identification Via TTY

3.25 Since the SCC performs corrective maintenance actions on the offices that it controls, a means is needed of verifying that the correct office has been selected.

3.26 Corrective actions or tests on an office can be performed only by using the TTY or the SCC console. The SCC hardware is wired so that before the SCC console becomes active, a TTY must be connected to the same office. Therefore, when a TTY connection is established, the SCC personnel should verify the connection.

3.27 The TTY message WHO-RU was designed to provide a means of identifying the office that receives the message. When the message is received at the central office, the office parameters are read by program and an output message identifying that particular office is printed on the same TTY channel the request for identification was inputted. The output message for office identification is an ID01.

3.28 The use of the WHO-RU message should prevent the SCC personnel from taking action on the wrong office and provide information concerning the program that is loaded in that office.

Hard Copy TTY Printouts

3.29 Since the SCC uses both the first and second maintenance TTY for communication with the central office, the maintenance TTY messages should always be printed on both channels. The existing hard copy TTY feature prints on both channels all input and output messages typed at either channel. The only method of stopping the feature is to type the

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input message that requests the feature to be shut off (SPY-NOMORE).

Emergency Action Print in a Phase

3.30 The emergency action print in a phase feature prints the corresponding phase message and rings the TTY bell during the emergency action phase to indicate to a remote location that a phase is in progress and how it is progressing.

E2A Telemetry Failure Reporting

3.31 The TTY output message AR01 MISC ALM has been expanded to alert maintenance personnel at the SCC of an E2A telemetry failure. An E2A telemetry failure is detected when the SCC location fails to request E2A data from the No. 1 ESS office. The message printed when an E2A telemetry failure is detected by the central office is AR01 MISC ALM MJ SPL 126.

3.32 The following SCC related function is available in the 1E4 and later generic programs.

Talk and Monitor Functions for HILO

3.33 The SCC talk and monitor functions for HILO are provided through a dedicated foreign exchange (FX) trunk. An incoming call via an FX trunk with a trunk program index (TPI) equal to 39, completes to a steady low tone circuit. When the low tone is received at the SCC location, the SCC operator types a T-TNN-TK message to complete the talk function. This message causes the FX trunk to be switched from the tone circuit to the trunk specified in the message [Fig. 2(a)]. The talking connection is abandoned by the SCC operator hanging up and typing a T-TNN-DC message, specifying the trunk network number of the trunk that was entered via the T-TNN-TK message.

3.34 To monitor a traffic busy trunk, the SCC operator types a T-TNN-MO message following the receipt of low tone. The FX trunk is now connected to a no test vertical (NTV) circuit, which is connected to the trunk specified in the message [(Fig. 2(b))]. When the monitor connection is established, the SCC operator can take any of the following actions after hanging up.

- (a) Release the monitor connection (T-TNN-RM).
- (b) Traffic release the monitored path (T-TNN-TR).

(c) Trace and hold the monitored path (T-TNN-TH).

(d) Release the path being held (T-TNN-RH).

3.35 The following SCC-related features are available with the indicated generic programs only if the universal control console at the SCC location and the expanded E2A remote unit at the central office are provided:

- Select Program Store Bus and Program Store State Control—(all active generic programs)
- Emergency Mode Control (EMC)—(1E4 and later generic programs)
- Program Synchronized A-Level Interrupt Control—(1E4 and later generic programs)
- Processor Interface (PI)—(1E5 and later generic programs).

Note: The PI lamps are used by offices utilizing PI frames for the Enhanced Private Switched Communications System (EPSCS) and the enhanced 911 (E911) service.

Select Program Store Bus and Program Store State Control Functions

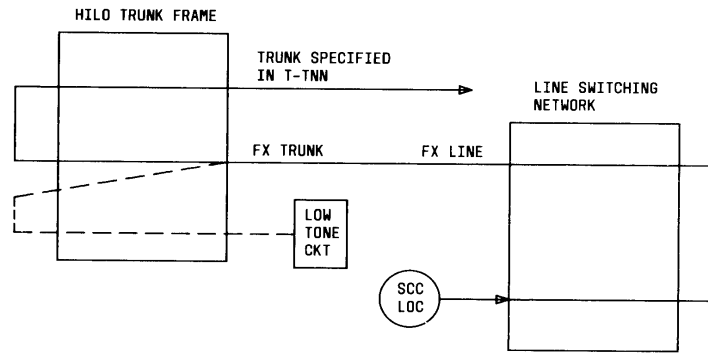
3.36 The select program store bus key must be used in conjunction with the program store state control switch, both of which are located on the universal control console. The select program store bus key provides the capability to force the specified program store bus to work with the active central control as part of recovery sequences. The program store state control switch provides the capability to manually select one of eight predetermined program store configurations to work with the active central control as part of recovery sequences.

Emergency Mode Control (EMC) Function

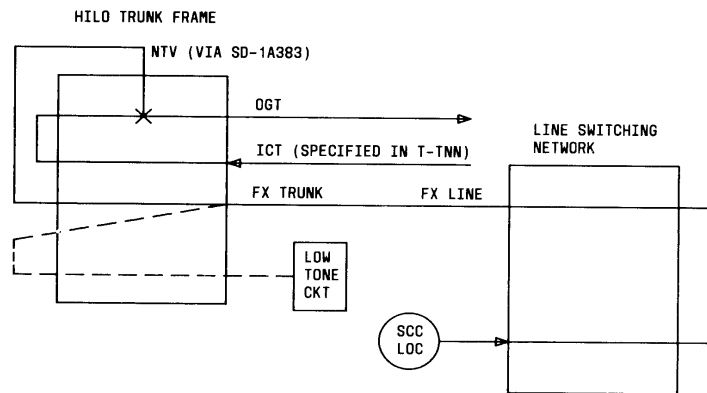
3.37 The EMC function is a supplement to existing manual recovery systems. The main function is a duplex failure mode which allows some useful information to be outputted even though the system is unable to call process because of massive equipment outages.

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(a) ARRANGEMENT FOR TALKING FUNCTION



(b) ARRANGEMENT FOR MONITOR FUNCTION

LEGEND:
 - - - - AFTER DN OF FX IS DIALED (PRIOR TO T-TNN MESSAGE)
 ——— AFTER T-TNN MESSAGE IS INPUT

Fig. 2—SCC Arrangement in a HILO Office

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Program Synchronized A-Level Interrupt Control Function

3.38 The program synchronized A-level interrupt control function allows the No. 1 ESS A-level capability to be tested in a manner that does not threaten the stability or sanity of the machine.

PI Lamps

3.39 The PI lamps reflect the status of the link between the No. 1 ESS and the No. 3A auxiliary processor of the peripheral data storage processor complex.

CTTU/RTTU Functions

3.40 The CTTU controls the RTTU over a dialup data link. One of the functions performed by the CTTU is to issue commands to and receive and interpret responses from the RTTU. While the actions performed by the RTTU may be complex, the craft person invokes them by simple keystrokes at the CTTU terminal. The CTTU constructs the command string required by the RTTU. Similarly, the CTTU accepts the RTTU responses and formats them into a human-readable form.

3.41 The CTTU provides a single terminal for the craft person to communicate with OSSs. The CTTU performs as a simple CRT/keyboard interface to each OSS. Since each craft person/OSS interface is somewhat unique, various performance aids are provided. These performance aids are specific to the trunk work station needs and relevant OSSs.

3.42 The CTTU contains a memory device for the temporary storage of information. The memory device serves to hold the permanent application programs of the CTTU itself and site dependent data. Also, the memory device serves as a scratch pad for retaining the data that craft personnel gather in the course of troubleshooting a trunk.

3.43 The control and communications capabilities of the CTTU are as follows:

- The ability to control the RTTU
- The ability to use a rudimentary, mechanized trouble ticket supplement.

3.44 The RTTU provides the interface to the switching system, and allows all the functions of the existing manual test panels to be remotely performed from the RTTU via the CTTU. The trunk and

line access, testing, and control provided by the RTTU are as follows:

- (a) The ability to respond to digital commands from the CTTU
- (b) The ability to respond to MF commands from all CAROT generics
- (c) The ability to seize, test, and control trunk circuits
- (d) The ability to seize and test lines
- (e) The ability to function automatically as a 105-type test line, or as a ROTL/responder toward a distant 105 test line
- (f) The ability to perform dc and transmission tests in an interactively-controlled manner
- (g) The ability to invoke ESS trunk diagnostics
- (h) The ability to set up a talk and monitor path between the trunk work station craft personnel and the trunk under test, when commanded to do so by the trunk work station craft personnel, or in response to incoming (manual) test calls to the RTTU from craft personnel at distant offices.

3.45 The RTTU provides the 105-type test line function at the terminating end of a trunk. The 105-type test line allows 2-way end-to-end transmission measurements to be made and the test results to be assembled at the originating end. The 105-type test line is used by the CAROT and Automatic Transmission Measurement System (ATMS) systems. Incoming test calls are routed to the test line by the switching machine. The test line answers the call and connects the responding equipment. A **parking chain** feature of the test line queues incoming calls until the responding equipment is available to accept commands from the originating equipment.

3.46 The RTTU can be used in place of the 52A ATMS and can be arranged to provide up to six 105-type test line ports. The RTTU accepts MF priming, measures 2-way loss, noise, noise-with-tone, gain slope, and balance and returns the results in the guard-data-guard format peculiar to the ATMS.

3.47 *Trunk Status Control:* The RTTU can lock out, disable, or restore a trunk.

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3.48 RTTU Interface: The RTTU with line testing provides all of the trunk testing capabilities of the MTTP and the line testing capabilities of the TLTP. Access to the RTTU is from a CTTU. In addition to providing universal access to trunks and lines, the RTTU with line testing interface preferentially routes incoming manual 101 test calls to the RTTU. This routing feature can be overridden if desired.♦

4. SYSTEM OPERATION

HARDWARE

4.01 At least one 4-wire path must be reserved from the No. 1 ESS central office to the SCC location for the telemetry system. An additional dedicated 4-wire path can optionally be reserved as a backup system. The telemetry system requires that this path be a 3002 unconditioned data grade voice bandwidth 4-wire facility.

4.02 A voice link which is not switched through the No. 1 ESS is required between the central office and SCC.

4.03 An E2A remote unit SD-1C539 is required to interface the central office with the SCC. The E2A remote unit is part of the telemetry system which passes signals between the SCC and the central office. An expanded E2A remote unit is required if the capabilities provided by the new universal control console are to be utilized. (See paragraphs 3.35 through 3.39.)

4.04 The master control center interface circuit SD-1A122 is required to connect the E2A remote unit to the master control center keys, lamps, and control switches. Option ZL of the interface circuit is required to accommodate the universal control console at the SCC and the expanded E2A remote unit if they are provided.

4.05 The TTY arrangements at the No. 1 ESS central office must be made compatible with the TTYs and TTY data sets at the SCC.

4.06 The TTYs linking the No. 1 ESS office to the SCC may be configured in one of the following ways:

- (a) The first configuration uses a universal input/output circuit SD-1A147 with 108D data sets.
- (b) A second configuration may be used with TTY circuits already equipped with the monitor

option and a 105A data set. This configuration requires a modification to the TTY circuit and 105A data set as specified for the ZV option in SD-1A121.

(c) The third configuration uses the standard arrangement for accessing the TTY channel from a remote location as outlined in SD-1A121 for the secondary (remote) maintenance TTY and in SD-1A147 for universal channels.

4.07 The SCC talk and monitor circuit SD-1A339 provides the means by which a switched voice or monitoring connection can be established between the SCC and the trunk under test via the trunk link network.

4.08 The network access circuit SD-1A176 serves as the interface between the SCC remote dc voltmeter and the trunk under test via the trunk link network.

4.09 The tone or recorded announcement circuit SD-1A218 serves as the interface between the SCC remote dc voltmeter and the SCC via the trunk link network.

4.10 A dedicated FX trunk SD-1A396 provides the SCC talk and monitor functions for the HILO feature.

4.11 ♦The RTTU frame, J1P051B, provides capabilities for centralized testing and is the standard 2-wire and HILO ESS maintenance frame for the SCC trunk work station CTTU. When the RTTU frame is installed in a No. 1 ESS office the set of scan and distribute points are assigned in the same way as the MTTP set of scan and distribute points. Alarm points and a remote off-line feature are provided to simplify the installation and maintenance of the frame. The frame provides remote manual and automatic transmission test capability to 100-, 102-, and 105-type test lines including connection appraisal tests; multimeter tests (ac, dc, resistance, capacitance); signaling state control, wink and pulsing tests (4A signaling set type tests); line tests (ringing, coin return and collect, and cutoff release in the 1E7 and later generic program; and trunk/office control features.

4.12 The RTTU frame assembly, J1P051B, is a standard 2 feet 2 inch wide by 12 inch deep ESS framework and is 7 feet high (Fig. 3). The frame

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terminal strip unit for frame to office connections is at the top. A data set shelf with ac power is provided for mounting the 212AR data sets. The line test panel provides all line test voltages. The control panel provides switch control of the alarms, off-line key to remove power from the scan drivers, and has telephone jacks and spare jacks. The power unit provides dc power to the frame. The control, access, and measurement (CAM) unit contains all of the frame electronics for measurement, access, and communications. The CAM unit occupies three shelves. The fuse panel provides primary fusing and has a frame power switch. The secondary power is also fused and both primary and secondary power is alarmed. The filter panel provides talk quality power to the frame.

4.13 The current drain for each RTTU frame is as follows:

- 6 amps at -48 volts
- 1 amp at +24 volts
- 1 amp at ±130 volts
- 0.75 amp at 105 volts (ringing).

4.14 The trunk circuits required to provide the No. 1 ESS/RTTU interface are shown in Table A.

4.15 The RTTU can terminate 105 and CAROT controlled transmission test calls.♦

OFFICE DATA STRUCTURES

A. Translations

4.16 A unit type 7, member number 1 auxiliary block (Fig. 4) provides for monitoring facilities for No. 1 ESS master control center functions and system state-of-health indicators for traffic functions. Word 0 of the auxiliary block contains the first of ten central pulse distributor points which are all nonfixed, bipolar, and are assigned consecutively; word 1 of the auxiliary block contains the first of 27 signal distributor points which are all nonfixed and are assigned consecutively.

4.17 A unit type 7, member number 0 auxiliary block (Fig. 5) is required to provide the SCC the ability to reset and disable the DTDA circuit via TTY input message. Also, this auxiliary block pro-

vides the capability to pass a fuse alarm indication to the SCC. Signal distributor points MJF and MNF in word 3 should be assigned for the fuse alarm indicators, and signal distributor points DTARST and DTAINH in word 5 should be reassigned for the DTDA circuit.

4.18 Unit type 34, member numbers 0 through 15 (normally saturated) and 64 through 79 (normally unsaturated) are used to report a building alarm condition to the SCC. If the unit type 34 auxiliary block consists of two words, then only member numbers 0 through 15 are used. Member numbers 64 through 79 are optional and are used only if the optional third word of the auxiliary block is present. The first of these building alarm scan points (member number 0) must be assigned for fire alarm. The other scan points (member numbers 1 through 15 and 64 through 79) can be assigned for such things as air conditioning troubles, high temperature indications, or any existing building alarms that are important to that office. Scan points for member numbers 0 through 15 should be consecutively assigned in the same scanner row; scan points for member numbers 64 through 79 should be consecutively assigned in another scan row. The functional layout of the unit type auxiliary block is given in Fig. 6.

4.19 The building alarm scan matrix, as represented by unit type 34, member numbers 0 through 15 and 64 through 79, are monitored for an abnormal state. If an abnormal state (alarm condition) is detected, the following actions are taken:

- (1) Call store flag word S3CPDON, bit 6 (BLD ALM) is updated.
- (2) Status of BLD ALM bit is transmitted via telemetry system to the SCC location.
- (3) The BLDG/PWR alarm critical indicator lamp at SCC is lighted.

4.20 A scan point must be assigned to the miscellaneous special alarm group of scan points for E2A telemetry failure reporting. This scan point should be assigned unit type 44, member number 126.

4.21 The SCC talk and monitor circuit requires special translations to be accessed from the SCC work station (Fig. 7). A description of the translations involved and the translation sequence used are as follows:

- (a) A dedicated 7-digit directory number (DN) is dialed from an SCC work location. The No. 1

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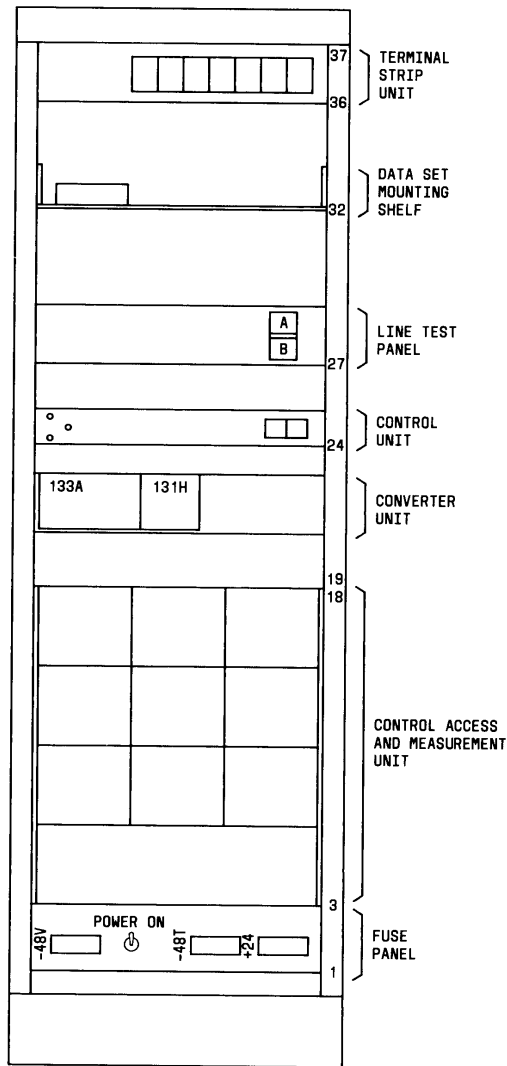


Fig. 3—RTTU Frame

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♦TABLE A♦

NO. 1 ESS/RTTU INTERFACE

FUNCTION	2-WIRE	QUANTITY	HILO	QUANTITY	COMBINED 2-WIRE/HILO	QUANTITY	CPI
Line Access Trunk	SD-1A176	1	NA		SD-1A176	1	
Master Test Trunk	SD-1A192	1	SD-1A367	1	SD-1A367	1	
Test Access Trunk	SD-1A322	1	SD-1A397	2	SD-1A322	1	
	SD-1A176/	1	SD-1A361	1	SD-1A397	2	
	SD-1A192	1			SD-1A361	1	
Dual Test Line	SD-1A303	2*	SD-1A388	4*	SD-1A303	2*	33
	SD-1A493	2*			SD-1A493	2*	206
					SD-1A388	4*	138

* Maximum

ESS translates this DN through the DN translator which returns a fixed route index of 168 and a program index of 1 (test call) (Fig. 8). A terminating major class of 3 (trunk group) must be specified in this line's directory number class (DNCL) word.

(b) Route index 168 is then translated through the route index expansion table to obtain a trunk group number.

(c) The trunk group number is used to derive the trunk class from the trunk class code expansion table. The trunk class code expansion table (Fig. 9) must specify that network appearance 0 for the SCC talk and monitor circuit should be on a miscellaneous trunk frame and have a circuit program index of 037. The trunk program index should be 9 for network appearance 0.

(d) The trunk group number is also used to input the trunk group number translator. From this translator, a list of trunk numbers is obtained. When an idle trunk is found, the trunk network number to peripheral equipment number translator is inputted to obtain trunk equipment data (Fig. 10).

(e) Once the SCC talk and monitor circuit has been accessed, SCC personnel can then type in input message T-TNN-MO specifying the trunk to be tested. This input message causes a connection to be made from test port 1 of the SCC talk and monitor circuit to the trunk under test. Test port 1 of this circuit (having trunk link network appearance 1) is a separate trunk circuit from network appearance 0. The trunk network number for network appearance 1 requires a trunk network number to peripheral equipment number auxiliary block as shown in Fig. 10.

(f) The trunk class code for network appearance 1 must specify a circuit program index of 037 and a trunk program index of 0.

(g) A fixed route index of 169 for network appearance 1 is used for connection between the SCC talk and monitor circuit and the trunk under test.

4.22 The SCC remote dc voltmeter circuit requires special translation to be accessed from the SCC work station (Fig. 11). A description of the translations involved and the translation sequence used are as follows.

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	22	21	20	19	18	17	16	15	14	13	12	11	8	7	4	3	0	
WORD 0	WRDN = 6				QUANT = 10				CPDN (TRA)									
1	QUANT = 27				MTDN (RMTN)													
2	PSEUDO LEN (1-PARTY RATE WITH CALL TRANSFER FEATURE)																	
3	ACC	D9			D10			D1			D2			D3				
4	D8			D4			D5			D6			D7					
5												*	†					

* INTER
† INTRA

LEGEND:

ACC - ACCESS CODE; EQUALS 1 WHEN ACCESS CODE REQUIRED.

D1-D10 - SCC DN. ZEROS ARE STORED AS TENS (BINARY 1010). D8, D9, AND D10 CONTAIN THE AREA CODE WHERE THE SCC IS IN A DIFFERENT AREA CODE.

INTER - INTEROFFICE INDICATOR; MUST BE SET TO 1 IF THE CALL IS TO BE TRANSFERRED OUTSIDE THE OFFICE (SCC NOT SERVED BY THIS OFFICE).

INTRA - INTRAOFFICE INDICATOR; MUST BE SET TO 1 IF THE CALL REMAINS IN THE OFFICE (SCC SERVED BY THIS OFFICE). INTER AND INTRA BITS SHOULD NOT BOTH BE SET, BUT ONE OF THEM MUST BE SET.

Fig. 4—Unit Type 7, Member Number 1—Auxiliary Block

	22	18	17	16	15	0
WORD 0	WRDN = 6					
1	QUANT = 12				MTDN (PDD)	
2	QUANT = 2		0	0	MSN-SUP (SCD)	
3	QUANT = 31				MTDN (CPDP)	
4	QUANT = 18				MTDN (PDI)	
5	QUANT = 5				MTDN (ASPOT)	

Fig. 5—Unit Type 7, Member Number 0—Auxiliary Block

(a) A dedicated 7-digit DN is dialed from the remote dc voltmeter circuit at the SCC. The No. 1 ESS translates this DN through the DN translator which returns a fixed route index of 166 and a program index of 1 (test call) (Fig. 8). A terminating major class of 3 (trunk group) must be specified in the associated DNCL word.

(b) Route index 166 is translated through the route index expansion table to obtain a trunk group number.

(c) The trunk group number is used to derive the trunk class from the trunk class code expansion table. The trunk class code expansion table

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22	11	10	9	8	7	6	3	2	1	0
0	0				DP = 2	I C ₁	SUPV = 11	0	TU = 2	
0	0									
0	0									
0	0				PAD=2	CPI = 146				

(a) SD-1A396 (HILO)

22	8	7	2	1	0	
0	0				TU = 3	
0	0					
0	0					
0	0				CPI (NOTE)	

NOTE: SD-1A176 CPI = 067 (2-WIRE)
 SD-1A218 CPI = 078 (2-WIRE)
 SD-1A339 CPI = 037 (2-WIRE)
 SD-1A397 CPI = 147 (HILO)

(b) SD-1A176, SD-1A218, SD-1A339 AND SD-1A397

22	11	10	9	8	7	6	3	2	0	
0	0				I C ₁	SUPV = 4	0	TU = 1		
0	0									
0	0									
0	0				MT	CPI = 13				

(c) SD-1A192 (2-WIRE)

22	11	10	9	8	7	2	1	0	
0	0				TU = 3				
0	0								
0	0								
0	0				MT	CPI = 107			

(d) SD-1A322 (2-WIRE)

Fig. 9—Trunk Class Code Expansion Tables for SD-1A396, SD-1A176, SD-1A218, SD-1A339, SD-1A397, SD-1A192, SD-1A361, and SD-1A367 (Sheet 1 of 2)

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22			8	7	6	2	1	0
0	*	0	0	I C T	SUPV = 3			TU = 3
0								
0								
0								
CPI = 111								

* CONF
(e) SD-1A361 (HILO)

22			8	7	6	2	1	0
0		0	0	I C T	0	0		TU = 1
0								
0								
0								
CPI = 117								

(f) SD-1A367 (HILO)

- LEGEND:
- CONF - CONFERENCE RESTRICTED = 1
 - CPI - CIRCUIT PROGRAM INDEX
 - ICT - IDLE CIRCUIT TERMINATION
 - MT - MESSAGE TRUNK = 2
 - OP - OUTPUTSING = 2 FOR DP
 - PAD - 2DB SWITCHABLE PAD = 2 FOR MESSAGE TRUNK
 - SUPV - SUPERVISION = 11 FOR GROUND START
 - TU - TRUNK USAGE = 2 FOR 2-WAY, = 3 FOR MISCELLANEOUS

Fig. 9—Trunk Class Code Expansion Tables for SD-1A396, SD-1A176, SD-1A218, SD-1A339, SD-1A397, SD-1A192, SD-1A361, and SD-1A367 (Sheet 2 of 2)

auxiliary block must specify that network appearance 0 for the remote dc voltmeter circuit should be on a miscellaneous trunk frame and have a circuit program index of 078. The trunk program index should be 9 for network appearance 0.

(d) The trunk group number is also used to input the trunk group number translator. From this

translator, a list of trunk network numbers is obtained. When an idle trunk is found, the trunk network number to peripheral equipment number translator for that trunk is used to obtain trunk equipment data (Fig. 10).

(e) Once the remote dc voltmeter circuit in the central office has been accessed, via circuit

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	22	18	17	16	15	0
WORD 0	WRDN = 4					
1	QTY = 2		MTDN			
2	QTY = 1		MSN SUPERVISORY			
3	QTY = 0		MSN DIRECTED = 0			

(a) AUXILIARY BLOCK FOR SD-1A339

	22	18	17	16	15	0
WORD 0	WRDN = 4					
1	QTY = 6		MTDN			
2	QTY = 4		MSN SUPERVISORY			
3	QTY = 0		MSN DIRECTED = 0			

(b) AUXILIARY BLOCK FOR SD-1A322

Fig. 10—♦Trunk Network Number to Peripheral Equipment Number Auxiliary Blocks♦

SD-1A218, SCC personnel can then type in input message T-TNN-VM specifying the trunk to be tested. This input message causes a connection to be made from test port 1 of the remote dc voltmeter circuit to the trunk under test, via circuit SD-1A176. Test port 1 of this circuit (having trunk link network appearance 1) is a separate trunk circuit from network appearance 0. The trunk network number for network appearance 1 requires a trunk network number to peripheral equipment number auxiliary block as shown in Fig. 10.

(f) The trunk class code for network appearance 1 must specify a circuit program index of 067 and a trunk program index of 0.

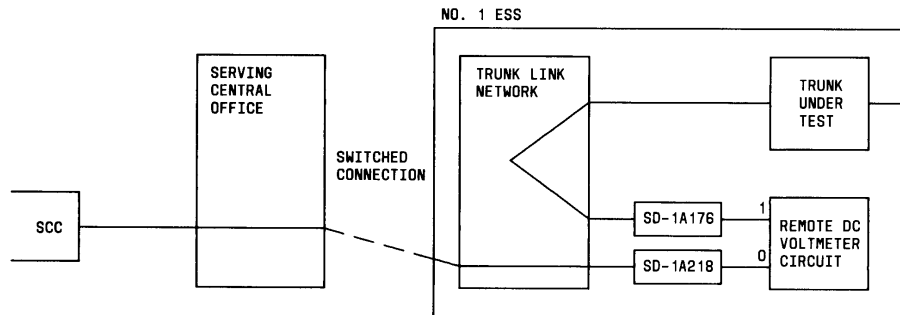
(g) A fixed route index of 167 for network appearance 1 is used for connection between the SCC remote dc voltmeter circuit and the trunk under test.

4.23 ♦The RTTU/CTTU feature group provides an MTTP-like interface with line access. This allows the RTTU to test lines as well as 2-wire and 4-wire HHO trunks. The term "line access" implies that all the line testing capabilities found at the TLTP, including the ability to answer an incoming intraoffice call, are made available at the RTTU.

4.24 To provide the RTTU with line testing a change in the unit type 8 auxiliary block (Fig. 12) is required. A new group of master scanner points are added to provide the scan points needed for line testing. The base master scanner number for these master scan points is placed in word 1 of the auxiliary block. A new set of signal distributor points are also needed. The base miscellaneous trunk distributor number (MTDN) for these signal distributor points is placed in word 4 of the auxiliary block. Word 9 of the auxiliary block contains the RTTU panel type and the line access trunk (SD-1A176) associated with the line access function, if equipped; otherwise 0.

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NOTE:
THE SCC USER IS REQUIRED TO DIAL THE ACCESS PORT 0 OF THE REMOTE DC VOLTMETER CIRCUIT IN THE CENTRAL OFFICE BEING TESTED. THE USER MUST DIAL THROUGH A SERVING CENTRAL OFFICE TO ENTER THE TEST OFFICE ON AN INCOMING TRUNK.

Fig. 11 — SCC Remote DC Voltmeter Circuit

4.25 There are two applications of the dual test line. These applications are the 105-type test line and the ROTL-line port. The applications are defined as follows:

(a) There are no new translation configurations for the RTTU 105-type test line application. Instead, the route index used for 105-type test lines is used for RTTU 105-type test lines. This implies that RTTU 105-type test lines and conventional 105-type test lines cannot coexist in the same office.

(b) The second application of the dual test line, the ROTL-like port, uses the translation structures in paragraph 4.24 through 4.32.

4.26 The 7-digit DN (either received from the originating end or expanded from the 3-digit access codes) is used to index the DN translator. The DN translator auxiliary block (Fig. 13) yields route index 188 for termination of the RTTU ROTL-like test line. A program index of 01 indicates a test call. A terminating major class of 3 (trunk group without ringing) is also specified in the auxiliary block.

4.27 Route index 188 is expanded through the route index expansion table translator (Fig. 14) when testing 2-wire incoming trunks in the tandem

state. Item RS (return supervision) is required to be set to one to indicate that the RTTU dual test line uses return answer supervision.

4.28 When testing 4-wire HILO trunks in the tandem state, route index 188 is used and correlates to pseudo route index 92. The pseudo route index is expanded through the pseudo route index table word (Fig. 15) to obtain the nonfixed route index which routes to the trunk group containing RTTU dual test line ROTL-like port.

4.29 The trunk group number translator (Fig. 16) contains the test table number for the trunk group, trunk class code, and number of trunks in the trunk group (members in the trunk group are RTTU dual test lines).

4.30 The trunk network number to trunk group number translator (Fig. 17) contains the trunk class code and the trunk group number for the RTTU dual test line. When set to 0, item LNGL indicates that the members are not Long Lines trunks.

4.31 The trunk class code expansion table (Fig. 18) must provide trunk usage = 11 and circuit program index (see Table A for proper circuit program index depending on type of circuit) for the RTTU dual test line.

4.32 The trunk network number to peripheral equipment number auxiliary block (Fig. 19)

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	22	18	17	16	15	14	13	0
WORD 0	WRDN = 20 (NOTE 1)		QTY CPD = 10		CPDN			
1	QTY = 4		0 0		MSN SC(42) GROUP 7			
2	QTY = 2		TPAC = 00		MSN SC(16) GROUP 3			
3	0 0 0 0 0		MTDN RA00-RA41					
4	QTY = 7 (NOTE 1)		MTDN RA42					
5	NEXT MEMBER NO.		0 0		MTT SD-1A367-02 (HILO) OR SD-1A192-01/05(2W)			
6	TTY CHAN.		0 0 0		TAT 1 SD-1A322-01 OR SD-1A176			
7	0 0 0 0 0 0 0 0		TAT 2 SD-1A322-01 OR SD-1A176					
8	0 0 0 0 0 0 0 0		TAT 3 SD-1A322-01 OR SD-1A192					
9	PANEL ID = 1000 ₀ (NOTE 2)		LAT SD-1A176-01					
10	0 0 0 0 0 0 0 0		SUBSTITUTE TRK1					
11	0 0 0 0 0 0 0 0		SUBSTITUTE TRK2					
12	QTY = 14		0 0		MSN SC(09) GROUP 5			
13	QTY = 8		0 0		MSN SC(28) GROUP 4			
14	QTY = 2		0 0		MSN SC(00) GROUP 1			
15	QTY = 15		0 0		MSN SC(02) GROUP 2			
16	0 0 0 0 0 0 0 0		HILO TAT 1 SD-1A397-02					
17	0 0 0 0 0 0 0 0		HILO TAT 2 SD-1A397-02					
18	0 0 0 0 0 0 0 0		HILO TAT 3 SD-1A361-02					
19	QTY = 1		0 0		MSN SC(41) GROUP 6			

- NOTES:
 1. QTY = 0 WITHOUT LINE ACCESS
 2. QTY = 100₀ WITHOUT LINE ACCESS

Fig. 12—Unit Type 8, Member Number 01 to 15—Auxiliary Block

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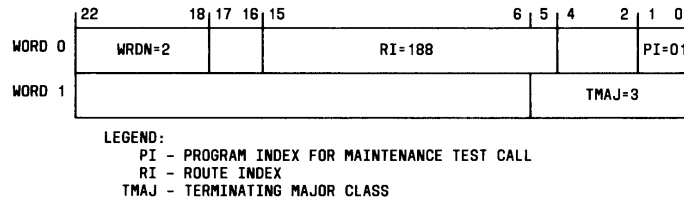
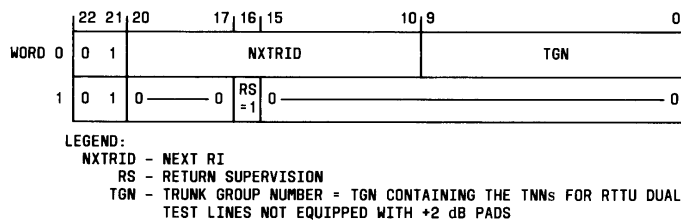
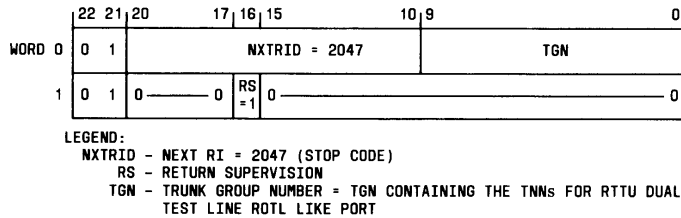


Fig. 13—Directory Number Translator—Auxiliary Block



(a) RI EXPANSION ENTRY FOR RI = 188



(b) NEXT RI EXPANSION ENTRY

Fig. 14—Route Index Expansion Table for Route Index 188

contains the master scan points and signal distribution information for the RTTU dual test line.

4.33 The master scanner translator (Fig. 20) provides the trunk network number and the trunk program index for the RTTU dual test line. Item TK set to one indicates this entry as a trunk-type entry.

4.34 The trunk network number to peripheral equipment number primary tables (Fig. 21) provide the translation data for universal trunks

mounted on the universal trunk frame or on the HILO universal trunk frame.

B. Parameters/Call Store

4.35 Three Compool-defined call store flag words, illustrated in Fig. 22, are used for updating the status of critical and system indicators.

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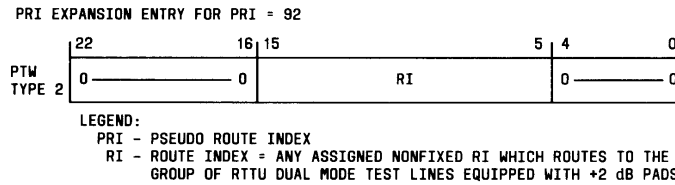


Fig. 15—Pseudo Route Index Table Word for Pseudo Route Index 92

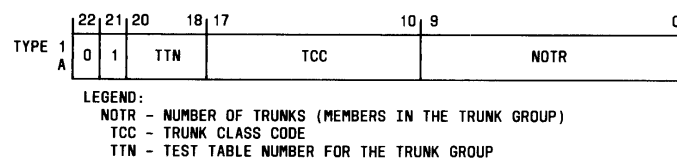


Fig. 16—Trunk Group Number Translator—Primary Translation Word

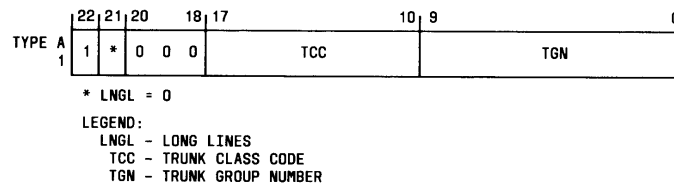


Fig. 17—Trunk Network Number to Trunk Group Number Translator—Primary Translation Word

4.36 These three words contain both critical indicator and system state-of-health indicator bits which are updated by appropriate programs. These status indications are then passed via the telemetry system to the SCC location.

FEATURE OPERATION

4.37 Feature flow diagrams giving the functional software operations of the SCC feature as applied by No. 1 ESS are shown in Fig. 23.

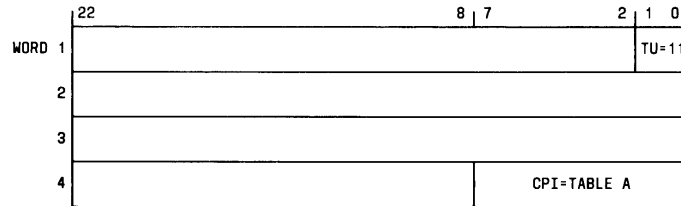
(a) System Indicators Functional Flow Diagram

(b) Critical Indicators Functional Flow Diagram

(c) Central Office Alarm Inhibit Mode Functional Flow Diagram

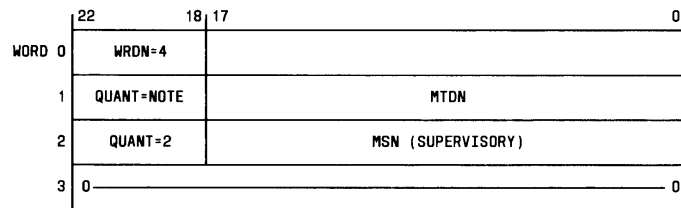
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LEGEND:
 CPI - CIRCUIT PROGRAM INDEX
 TU - TRUNK USAGE.

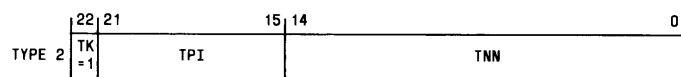
Fig. 18—Trunk Class Code Expansion Table for the RTTU Dual Test Line



NOTE:
 QUANT=2 (SD-1A303)
 QUANT=2 (SD-1A388)
 QUANT=3 (SD-1A493)

LEGEND:
 MSN - MASTER SCANNER NUMBER
 MTDN - MISCELLANEOUS TRUNK DISTRIBUTOR NUMBER
 QUANT - QUANTITY.

Fig. 19—Trunk Network Number to Peripheral Equipment Number Auxiliary Block for the RTTU Dual Test Line



LEGEND:
 TK - TRUNK IDENTIFIER
 TNN - TRUNK NETWORK NUMBER
 TPI - TRUNK PROGRAM INDEX.

Fig. 20—Master Scanner Translator—Primary Translation Word (Typical)

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22	21	20	17	16	15	9	8	7	4	3	2	1	0
1	P T S			M A T E		FRAME	B A Y		PLATE		FILE	C K T	

(a) 2-WIRE

22	21	20	16	15	10	9	8					1	0
1	P T S				FRAME/2	B A Y							CIRCUIT NO.

(b) 4-WIRE

LEGEND:
PTS - CIRCUITS PER UNIT

Fig. 21—Trunk Network Number to Peripheral Equipment Number Primary Translation Words for Universal Trunks

(d) Dial Tone Delay Alarm Circuit Control From SCC Functional Flow Diagram

(e) Central Office Identification Functional Flow Diagram.

4.38 For function software operations of the RTTU/CTTU feature refer to reference A(21) in Part 18.

CHARACTERISTICS

5. FEATURE ASSIGNMENT

5.01 The SCC feature is provided on a per No. 1 ESS central office basis.

6. LIMITATIONS

OPERATIONAL

6.01 If controls at the SCC force the No. 1 ESS central office into a special configuration and then the emergency power release function at the SCC is operated, all SCC operated controls are released at the ESS office.

6.02 After the SCC configures the ESS office and then disconnects (because of little activity in the office), the ESS office remains in that configuration.

6.03 When control is given over to the SCC from the central office, all central office controls

should be in a nonoperated state. This allows the SCC to have full control over the office since office-initiated configurations override SCC-initiated configurations.

ASSIGNMENT

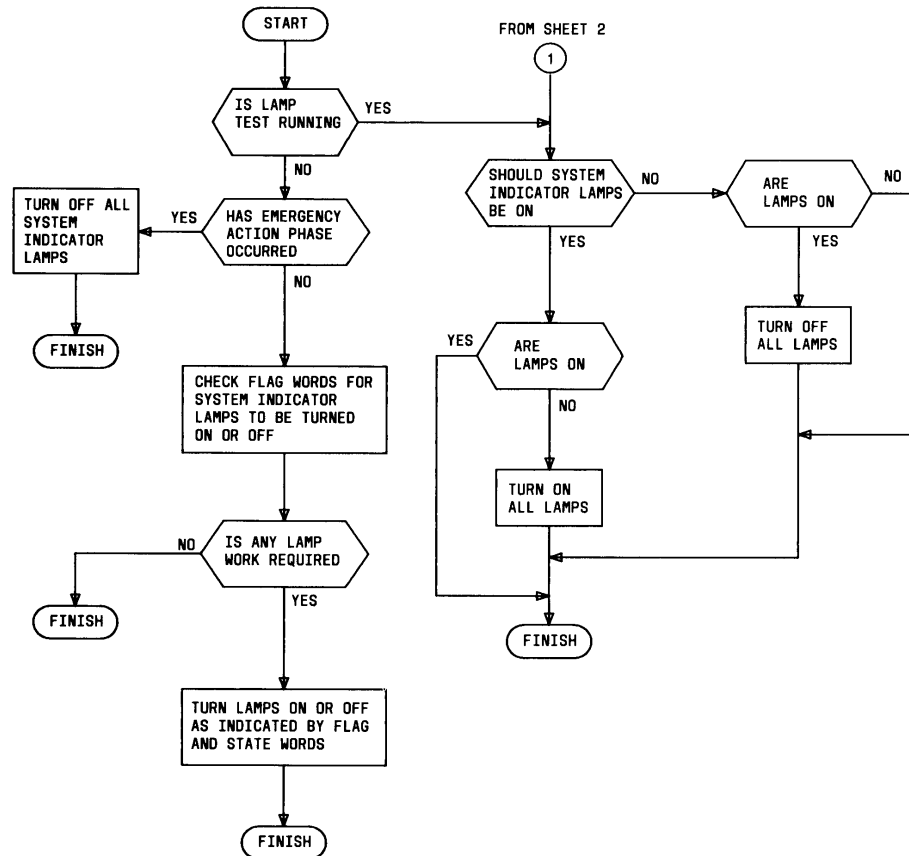
6.04 The office code (first three digits of the 7-digit DN) of the line used by the SCC personnel to dial the talk and monitor circuit or the remote dc voltmeter circuit must be a code assigned to the office which has these circuits. Within a single office, lines are not connected directly to that office's trunk network. Incoming trunk connections must occur via an intervening office.

6.05 An RTTU may be assigned to only one office. However, an office may be equipped with up to 15 RTTUs.

6.06 Each dual test line module in the RTTU provides two incoming trunk terminating test line appearances. The dual test line module is normally arranged to provide 105-type test line service at the RTTU frame. A maximum of four dual test line modules (eight test lines) may be installed. Test lines 1, 2, 3, and 4 are used to provide 4-wire service while test lines 5, 6, 7, and 8 are used to provide 2-wire service. Only test lines 1 and 2 are furnished standard with the frame. All other test lines are optional and are ordered as list options. The following are possible arrangements for a HILO office.

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(a) SYSTEM INDICATORS FUNCTIONAL FLOW DIAGRAM

Fig. 23—Functional Flow Diagrams of Software Operations for the SCC Feature (Sheet 1 of 5)

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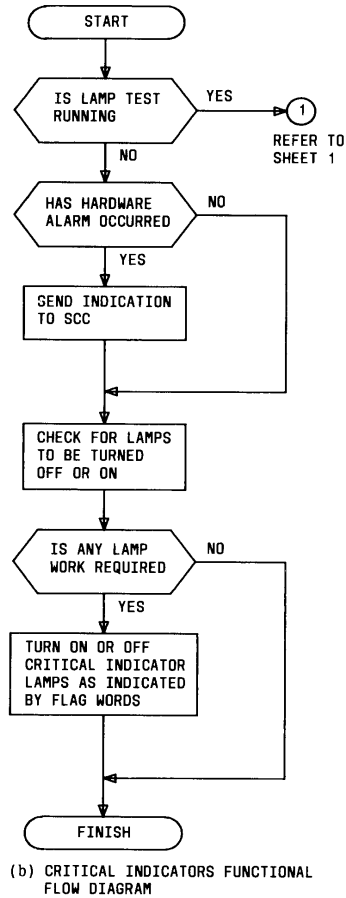
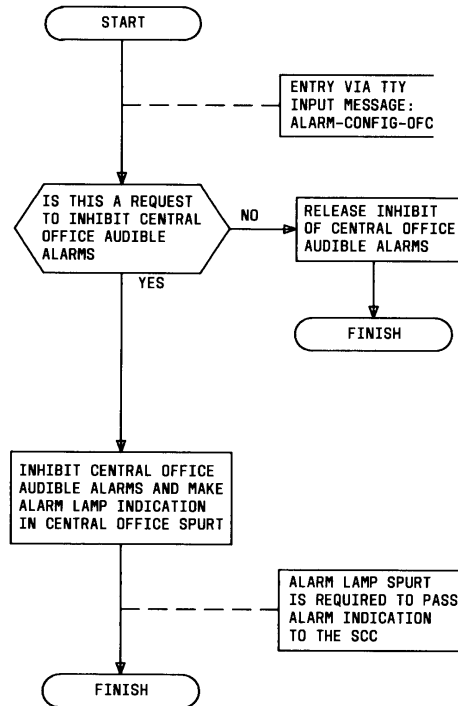


Fig. 23—Functional Flow Diagrams of Software Operations for the SCC Feature (Sheet 2 of 5)

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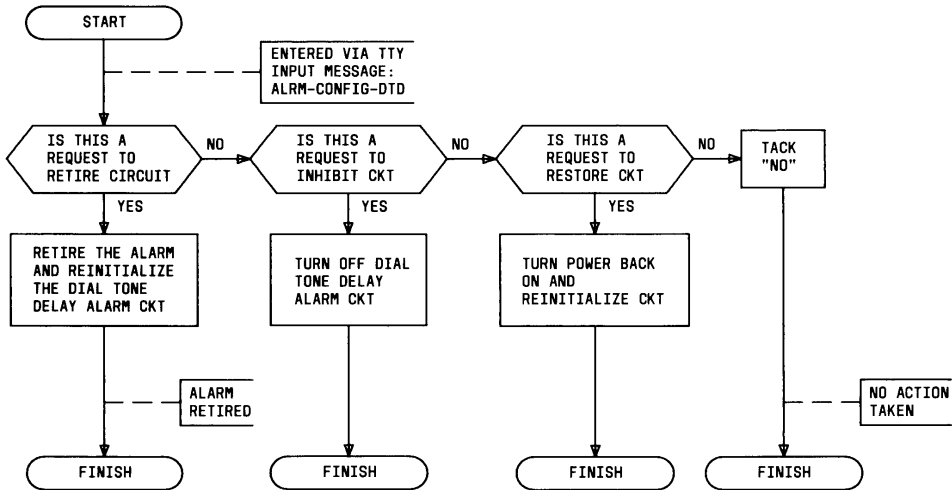


(c) CENTRAL OFFICE ALARM INHIBIT MODE
FUNCTIONAL FLOW DIAGRAM

Fig. 23—Functional Flow Diagrams of Software Operations for the SCC Feature (Sheet 3 of 5)

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(d) DIAL TONE DELAY ALARM CIRCUIT CONTROL FROM SCC FUNCTIONAL FLOW DIAGRAM

Fig. 23—Functional Flow Diagrams of Software Operations for the SCC Feature (Sheet 4 of 5)

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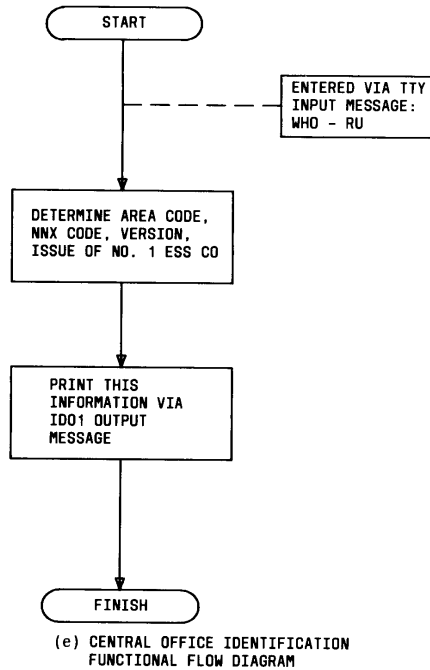


Fig. 23—Functional Flow Diagrams of Software Operations for the SCC Feature (Sheet 5 of 5)

- (a) The possible arrangements for 4-wire are as follows:
- (1, 2)
 - (1, 2, 3, 4)
 - (1, 3, 4) when 2 is arranged to be a ROTL port.
- (b) The possible arrangements for 2-wire are as follows:
- (5, 6)
 - (5, 6, 7, 8)
 - (5, 7, 8) when 6 is arranged to be a ROTL port.

6.07 The possible test line arrangements for a 2-wire only office are as follows:

- (1, 2)
- (1, 2, 5, 6)
- (1, 2, 5, 6, 7, 8)
- (1, 5, 6, 7, 8) when (2) is arranged to be a ROTL port.

6.08 All test line numbers in parenthesis must be arranged in a hunt group. When the ROTL port is desired, test line (6) must have its own 7-digit access number and must not be part of the hunt group.

7. INTERACTIONS

7.01 Not applicable.

8. RESTRICTION CAPABILITY

8.01 The RTTU frame may be taken off-line remotely by SCC craft personnel by entering a T-MISD message on the maintenance channel. This message requests that a miscellaneous signal distributor point be operated to remove interface power.

INCORPORATION INTO SYSTEM

9. INSTALLATION/ADDITION/DELETION

9.01 The procedure for adding the SCC feature to No. 1 ESS central office is shown in Fig. 24. Refer to Part 13 for testing procedures.

9.02 The procedure for adding the RTTU/CTTU feature to the No. 1 ESS central office is shown in Fig. 25. Refer to Part 13 for testing procedures.

9.03 Set card SCCE (Is Office Equipped With SCC Hardware) is required for the SCC feature. It should be set to 1 to indicate that the office is equipped with the necessary monitoring system facility (SCC hardware).

9.04 Set cards 9SR2C2, 9FR2C2, 9SMTTP, and 9FMTTP must be set to 1 to provide the RTTU/CTTU feature.

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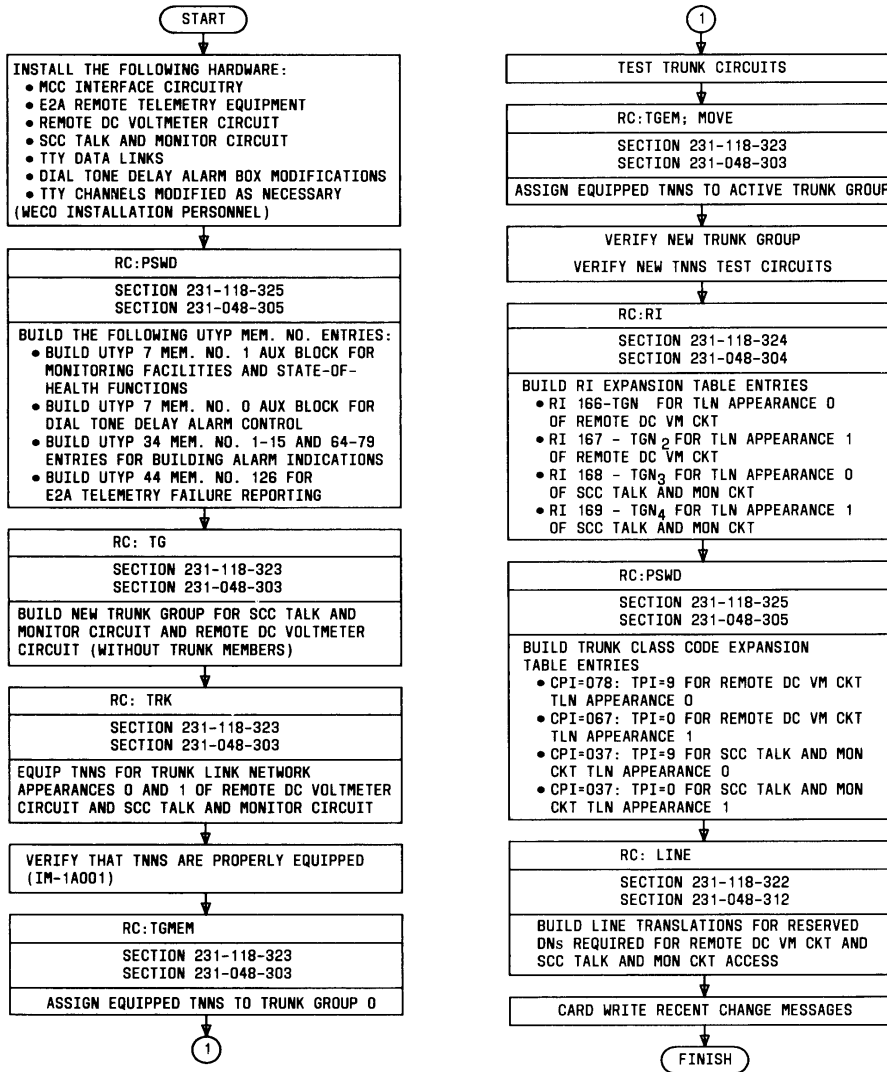


Fig. 24—Procedure for Adding the SCC Feature

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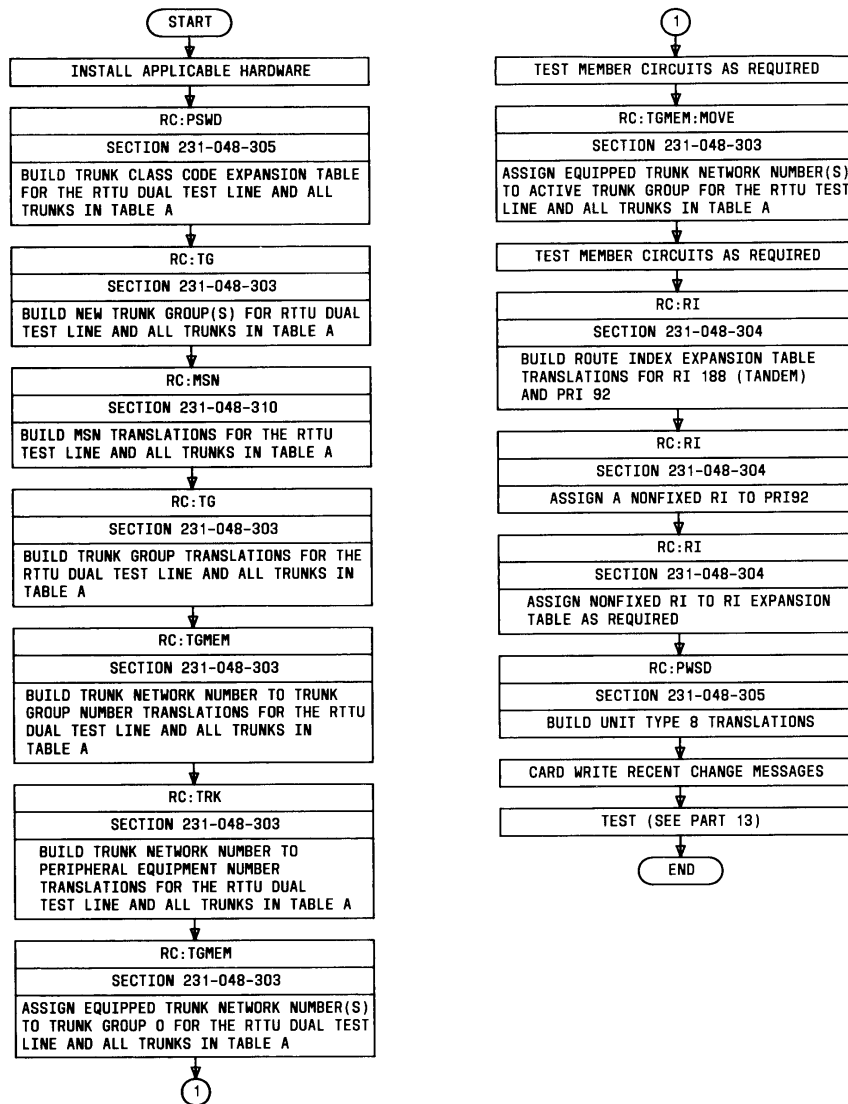


Fig. 25—Procedure for Adding the RTTU/CTTU Feature

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10. HARDWARE REQUIREMENTS

Note: This part contains cost factors and determination of quantities. Central Office Equipment Engineering System (COEES) Planning and Mechanized Ordering Modules are the recommended procedures for developing these requirements. However, for planning purposes or if COEES is not available, the following guidelines may be used.

10.01 An E2A remote unit SD-1C539-01 located in the central office is part of the telemetry system which passes signals and status information between the SCC and the central office. This E2A remote unit is connected to an E2A central located at the SCC. Up to 16 E2A remote units, representing up to 16 central offices, can be connected to one E2A central.

10.02 A master control center interface circuit SD-1A122-02 (option A [J1A042A]) located in the central office on the master control center frame is required with the SCC feature. This circuit is mounted on the master control center frame and connects the E2A remote unit to the master control center keys, lamps, and control switches. Information derived from these master control center sources is transmitted to the SCC for the critical indicator panels and the SCC work station consoles. Option ZL of the master control center interface circuit SD-1A122-02 is required if the universal control console at the SCC and the expanded E2A remote unit SD-1C539-01 at the central office are provided.

10.03 The TTY arrangements at the central office must be compatible with the TTY data sets at the SCC. The TTYs at the central office may be configured in one of three ways:

(a) The first configuration uses a universal input/output circuit SD-1A147-02 (J1A041BD) with 108D data sets. New central office installations should order this circuit for all TTY channels. Existing offices may replace TTY circuits SD-1A147-01 with this input/output circuit for channels that are to be routed to the SCC. The TTY channels arranged in this first configuration (using the SD-1A147-02 unit) do not echo typed characters back to the TTY.

(b) A second configuration can be used with TTY circuits already equipped with the monitor

option and a 105A data set. This arrangement applies to the maintenance channels and to (old) universal channels when both local and remote 2-way TTY access is required. This configuration requires a modification to the TTY circuit and 105A data set as specified for the ZV option on SD-1A121-02 (J1A041BB). This modification makes the monitor port of the TTY channel a 2-way port and makes the 105A data set compatible with the SCC 108E data set. The TTY channels arranged in this manner will echo typed characters back to the TTY.

(c) The third configuration uses the standard arrangement for accessing the TTY channel from a remote location as outlined in SD-1A121-02 for the secondary (remote) maintenance TTY and in SD-1A147-01 or SD-1A147-02 for universal channels. In addition to the standard arrangement for accessing the channel from a remote location, the data set strapping change to force the originate mode for the 105A data set must be made to make the 105A compatible with the 108E data set. The TTY channels arranged in this manner do not echo typed characters back to the TTY.

10.04 The SCC talk and monitor circuit SD-1A339-01 (trunk order code 03700) (J1A033GV) is located in the central office on the miscellaneous trunk frame. This circuit has one network appearance and requires two scan points and five signal distributor points.

10.05 The network access circuit SD-1A176-01 (trunk order code 06770) (J1A032BC) and the miniaturized circuit SD-1A176-05 (trunk order code 06700) (J1A084BC) are located in the central office on the universal trunk frame and miniaturized trunk frame, respectively. This circuit has one network appearance and requires two scan points and two signal distributor points.

10.06 The tone or recorded announcement circuit SD-1A218-01 (trunk order code 07870) (J1A032DC) and the miniaturized circuit SD-1A218-05 (trunk order code 07800) (J1A084DC) are located in the central office on the universal trunk frame and miniaturized trunk frame, respectively. This circuit has one network appearance and requires one scan point and two signal distributor points.

10.07 A dedicated FX trunk SD-1A396-01 or -02 (trunk order code 14600 and 14601, respec-

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tively) (J1A090BJ) is mounted on the HILO universal trunk frame. The indicated circuits are functionally the same. This circuit has one network appearance and requires two scan points and three signal distributor points.

10.08 Ten bipolar central pulse distributor points and 27 signal distributor points are utilized by unit type 7, member number 1. This member number provides monitoring facilities for the ESS master control center functions and system state-of-health indicators at the SCC.

10.09 Four signal distributor points are utilized by unit type 7, member number 0. Two of these points provide the SCC the ability to reset and disable the DTDA circuit via a TTY input message. The other two points provide the capability for the ESS office to pass a fuse alarm indication to the SCC.

RTTU

10.10 All of the maintenance test capabilities currently available at the MTTP and TLTP can be provided via a RTTU interface to a CTTU located at the SCC. The two distinct RTTU interfaces to the ESS appear as trunk test panels on the switch and are analogous to the current hardware trunk test panels.

10.11 The RTTU mounts on its own frame with the maximum distance from the transmission reference network point limited to 400 feet from the transmission measuring equipment at the RTTU to the junctor grouping frame. A remote power option is required for RTTUs more than 450 feet from the central pulse distributor. When the RTTU frame is equipped for remote power, the bipolar central pulse distributor points must first be fitted with (or connected to) the central pulse distributor applique circuit SD-1A431-01. Once the bus limit of 450 feet has been exceeded, there can be no direct connection between the RTTU and the central pulse distributor. The RTTU frame requires 10 bipolar central pulse distributor points, 46 supervisory master scanner points, and 49 signal distributor points.

10.12 The 2-way trunk circuit (master test trunk) SD-1A192-02 (trunk order code 01300 [J1A084CB]) and the miniaturized circuit SD-1A192-05 (trunk order code 01306 [J1A084CB]) are located in the central office on the universal trunk frame and miniaturized trunk frame, respectively.

The SD-1A192-02/05 circuit has one network appearance and requires two scan points and three signal distributor points. One 2-way trunk circuit is required per RTTU panel. This circuit is required in offices equipped with 2-wire trunk link networks.

10.13 The network access and terminal balance access circuit (test access trunk) SD-1A322 (trunk order code [J1A033JP]) is located in the central office on the miscellaneous trunk frame. This circuit has three network appearances and requires four scan points and six signal distributor points. One network access and terminal balance access circuit is required per RTTU panel. This circuit is required in offices equipped with 2-wire trunk link networks. Two SD-1A176 and one SD-1A176 circuits may be used in place of the SD-1A322 circuit.

10.14 One 2-way E&M supervision wink start 2-wire facility trunk circuit is required only in ESS offices equipped with HILO trunk link networks or HILO and 2-wire trunk link networks.

10.15 The incoming loop reverse battery supervision 2-wire facility trunk circuit (master test trunk) SD-1A367 (trunk order code 11701 [J1A090BC]) is located in the central office on the HILO universal trunk frame. One incoming loop reverse battery supervision 2-wire facility trunk circuit is required in ESS offices equipped with HILO trunk link networks or HILO and 2-wire trunk link networks. This circuit has one network appearance and requires two scan points and three signal distributor points. One incoming loop reverse battery supervision 2-wire facility trunk circuit is required per RTTU panel. This trunk circuit is required to test HILO trunks.

10.16 The trunk test access circuit (test access trunk) SD-1A397 (trunk order code 14701 [J1A090BK]) is located in the central office on the HILO universal trunk frame. This circuit has one network appearance and requires two scan points and two signal distributor points. Two trunk test access circuits are required per RTTU panel. This trunk circuit is required to test HILO trunks.

10.17 The 2-way E&M supervision wink start 2-wire facility trunk circuit (test access trunk) SD-1A361 (trunk order code 11100 [J1A090BA]) is located in the central office on the HILO universal trunk frame. This circuit has one network appearance and requires two scan points and three signal

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distributor points. One 2-way E&M supervision wink start 2-wire facility trunk circuit is required per RTTU panel. This trunk circuit is required only when HILO trunks are in the office.

10.18 The dual test line module in the RTTU provides a pair of incoming trunk terminating test line appearances. For CAROT compatibility, an optional multifrequency ROTL-like port can be installed. This port can be expected to take approximately 6 seconds longer per test access than the RTTU input port with its high speed BX.25 data interface. The RTTU port exchanges communications digitally whereas the ROTL signaling arrangement uses MF digits, test progress tones, and recycle tones which add several seconds per test. One of the 105-type test line accesses must be used to provide this function (enabled by switch settings and strap option). A different office trunk circuit is needed in HILO feature offices to convert to 2-wire transmission. The dual test line module is mounted on the RTTU frame.

10.19 The RTTU provides up to four 105-type test line ports. (The No. 1 ESS RTTU equipped for HILO has a maximum of eight ports.) Incoming calls are answered, parked, and served in arrival order as the responder module becomes available.

10.20 One dual test line module that provides two ports is standard. In 2-wire switch frames, one additional module may be installed to bring the total to four ports. In the HILO optional RTTU frame, three modules may be added to bring the total to eight test lines. Test line port 2 can be arranged to provide the ROTL-like multifrequency control access to RTTU.

10.21 The telephone company must determine the number of test line circuits to provide for each installation. Test lines must be arranged in trunk groups whose size is determined by traffic considerations. Separate trunk groups must be installed for each combination of 2- or 4-wire transmission level point (TLP) and impedance that the office provides. A separate one-member group must be installed if the ROTL feature is desired.

10.22 The 105-type test line supports all normal 52A responder test capabilities.

10.23 In No. 1 ESS offices, test lines 1, 2, 3, and 4 are used to provide 4-wire service, while test

lines 5, 6, 7, and 8 are used to provide 2-wire service. Only test lines 1 and 2 are furnished standard with the frame. These test lines may be arranged for 2-wire service if the office is only 2-wire. Additional test lines are optional and are ordered as list options. All test line numbers in parenthesis must be arranged in one or more trunk groups. Each trunk group must have homogenous characteristics of wires, TLP, and impedance. The possible test line arrangements are as follows:

(a) For 4-wire service:

- Test lines (1, 2) arranged as 105-type test lines
- Test lines (1, 2, 3, 4) arranged as 105-type test lines
- Test lines (1, 3, 4) arranged as 105-type test lines when test line 2 is arranged to provide 2-wire ROTL port.

(b) For 2-wire service:

- Test lines (5, 6) arranged as 105-type test lines
- Test lines (5, 6, 7, 8) arranged as 105-type test lines
- Test lines (5, 7, 8) arranged as 105-type test lines when test line 6 is arranged to provide 2-wire ROTL port.

(c) For 2-wire only installations:

- Test lines (1, 2) arranged as 105-type test lines
- Test lines (1, 2, 5, 6) arranged as 105-type test lines
- Test lines (1, 2, 5, 6, 7, 8) arranged as 105-type test lines
- Test lines (1, 5, 6, 7, 8) arranged as 105-type test lines when test line 2 is arranged to provide the ROTL port.

10.24 When the ROTL feature is desired, test line 2 must have its own 7-digit access number in a 1-member trunk group and must not be part of any

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105-type test line trunk group. This arrangement uses route index 188 or pseudo route index 92 and route index 188 for HILO.

10.25 The RTTU dual test line consists of either an SD-1A493 or SD-1A303 2-wire transmission test coupler or an SD-1A388 4-wire HILO transmission test coupler, and a 105-type test line circuit. The RTTU dual test line is mounted on the miscellaneous trunk frame. The SD-1A303 and SD-1A388 RTTU dual test lines have one network appearance and require two scan points and two signal distributor points. The SD-1A493 dual test line has one network appearance and requires two scan points and three signal distributor points.♦

11. SOFTWARE REQUIREMENTS

Note: This part contains cost factors and determination of quantities. Central Office Equipment Engineering System (COEES) Planning and Mechanized Ordering Modules are the recommended procedures for developing these requirements. However, for planning purposes or if COEES is not available, the following guidelines may be used.

MEMORY

A. Fixed

11.01 The following memory is required whether or not the Interface With Switching Control Center System feature is used.

- (a) **Base Generic Program (Program Store):** Approximately 760 words are required for the Operation With Switching Control Center feature. ♦An additional 144 words are required when the RTTU/CTTU feature is added.♦
- (b) **Fixed Parameters (Program Store):** Two words are required (for updating time activity words in E4PAUL).
- (c) **Compool Defined Words (Call Store):** Fourteen words are required.

B. Conditional

11.02 ♦The memory requirements in paragraph 11.03 are required only when the RTTU/CTTU feature is activated.

11.03 **Optionally Loadable Feature Groups:** The feature groups required for the RTTU/CTTU feature and the size of each group is as follows.

- (a) **MTTP:** The MTTP feature group contains 1534 words.
- (b) **R2C2:** The R2C2 feature group contains 318 words.♦

C. Variable

11.04 The following **translations (program store)** memory is required only when the Interface With Switching Control Center System feature is applied.

- (a) **Master Control Center Control and Display Circuit (Unit Type 7, Member Number 0) Auxiliary Block:** Six words are required.
- (b) **Master Control Center Monitoring Facility (Unit Type 7, Member Number 1) Auxiliary Block:** Six words are required.
- (c) **Miscellaneous Building Alarm-Major (Unit Type 34, Member Number 0) Auxiliary Block:** Three words are required.
- (d) **Master Scanner Translations:** One primary translation word is required for the miscellaneous special alarm (unit type 44, member number 126).
- (e) **Route Index Expansion:** Sixteen words are required (one 4-word route index expansion for each network appearance of the SCC talk and monitor circuit and one 4-word route index expansion each for network appearance 1 of the network access circuit and network appearance 0 of the tone or recorded announcement circuit).
- (f) **Directory Number Subtranslator:** Two words are required (one each for the SCC talk and monitor circuit and the SCC remote dc voltmeter circuit).
- (g) **Trunk Class Code Expansions:** Sixteen words are required in 2-wire offices (one 4-word trunk class code expansion for both network appearances 0 and 1 of the SCC talk and monitor circuit and one 4-word trunk class code expansion each for the network appearance of the network access circuit and the network appearance of the tone or recorded announcement circuit). An additional four words are required in HILO offices for the network appearance of the FX trunk circuit.

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(h) **Trunk Network Number to Peripheral Equipment Number Auxiliary Block:**

Sixteen words are required (one 4-word trunk network number to peripheral equipment number auxiliary block for each network appearance of the SCC talk and monitor circuit and one 4-word trunk network number to peripheral equipment number auxiliary block each for the network appearance of the network access circuit and the tone or recorded announcement circuit).

(i) **Unit Type 8 Auxiliary Block:** Twenty words are required.

(j) **Directory Number Translator Auxiliary Block:** Two words are required.

(k) **Route Index Expansion Table for Route Index 188:** Two words are required.

(l) **Route Index Expansion Table for Pseudo Route Index 92:** One word is required.

(m) **Trunk Group Number Translator—Primary Translation Word:** One word is required per trunk group.

(n) **Trunk Network Number to Trunk Group Number Translator—Primary Translation Word:** One word is required per circuit.

(o) **Trunk Class Code Expansion Table for the RTTU Dual Test Line:** Four words are required.

(p) **Trunk Network Number to Peripheral Equipment Number Auxiliary Block for the RTTU Dual Test Line:** Four words are required per test line.

(q) **Master Scanner Translator—Primary Translation Word:** One word is required per scan point.

(r) **Trunk Network Number to Peripheral Equipment Number Primary Translation Words for Universal Trunks:** One word is required per trunk circuit.

REAL TIME IMPACT

11.05 The increase in real-time consumption for No. 1 ESS because of interface with SCC is

0.19 percent of system real time, regardless of office load.

11.06 Cycle times for No. 1 ESS are as follows: 5.5 microseconds (0 percent speedup) or 5.0 microseconds (10 percent speedup). Clock speedup is available with 1E7 and base restarts of the 1E6 generic programs.

12. DATA ASSIGNMENTS AND RECORDS

TRANSLATION FORMS

12.01 The following ESS translation forms, detailed in reference C(1) in Part 18, are applicable to the Interface With Switching Control Center System feature.

- ESS 1101—Directory Number Record
- ESS 1200-1/4—Universal Trunk Frame Record
- ESS 1201A, B—Miscellaneous Trunk Frame Record
- ESS 1204—Trunk Class Code Record
- ESS 1216A, B, C and D—Trunk Group Supplementary Record
- ESS 1221A—Miscellaneous Trunk Frame (HILO) Record
- ESS 1303—Trunk and Service Route Index Record
- ESS 1500B—General Information Record
- ESS 1506—Miscellaneous Assignment Information Record
- ESS 1600—Master Scanner Record
- ESS 1601—Central Pulse Distributor Record
- ESS 1602—Miscellaneous Signal Distributor Record.

RECENT CHANGES

12.02 There are no unique key words or recent change messages applicable to the Interface With Switching Control Center System feature.

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13. TESTING

13.01 Testing of the No. 1 ESS central office interface with the SCC is done in the following sequence:

- (1) The E2A Telemetry System must be tested. For detailed information on testing procedures, see reference A(5) in Part 18.
- (2) The master control center interface circuitry should be tested next. See references A(3) and A(4) in Part 18 for master control center interface circuit testing procedures.
- (3) The console control loop-around test should be performed last. This is an SCC initiated test which checks telemetry, interface, and console circuitry. [See reference A(1) in Part 18.]
- (4) Use the T-READ- input message to read and verify unit type member number and trunk class code entries. The system response is PF followed by a TW02 output message.
- (5) Use the VFY-TKGN- input message to verify trunk group number translations associated with the SCC talk and monitor, remote dc voltmeter, and RTTU dual test line circuits. The system response is OK followed by a TR10 output message.
- (6) Use the VFY-TNN- input message to verify trunk network number translations associated with the SCC talk and monitor, remote dc voltmeter, and RTTU dual test line circuits. The system response is OK followed by a TR14 output message.
- (7) Use the VFY-EXP- input message to verify route index expansion table entries. The system response is OK followed by a TR05 output message.
- (8) Use the VFY-DN- input message to verify DN translations required for the SCC talk and monitor, remote dc voltmeter, and RTTU dual test line circuits. The system response is OK followed by a TR01 or TR08 output message.
- (9) Use the VFY-MSN- input message to verify master scanner translations. The system response is OK followed by a TR12 output message.

14. OTHER PLANNING TOPICS

14.01 Not applicable.

ADMINISTRATION

15. MEASUREMENTS

15.01 Not applicable.

16. CHARGING

AUTOMATIC MESSAGE ACCOUNTING

16.01 Not applicable.

UNIFORM SERVICE ORDER CODES

16.02 Not applicable.

SUPPLEMENTARY INFORMATION

17. GLOSSARY

17.01 Not applicable.

18. REFERENCES

18.01 The following documentation contains information related to or affected by the Interface With Switching Control Center System feature.

A. Bell System Practices

- (1) Section 190-110-110—Common Application—Description—No. 2 Switching Control Center System
- (2) Section 190-113-110—Description and Operation—No. 2 Switching Control Center System—No. 1 Electronic Switching System Application
- (3) Section 190-113-310—Operating and Diagnostic Test Procedures—No. 2 Switching Control Center System—No. 1 Electronic Switching System Application
- (4) Section 190-113-340—Operating and Diagnostic Test Procedures (CC1A)—No. 2 Switching Control Center System—No. 1 Electronic Switching System Application
- (5) Section 201-653-502—E2A Telemetry—Switching Control Center—Central and Remote Maintenance

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- (6) Section 231-017-301—Dial Tone Delay Alarm Operation—2-Wire No. 1 Electronic Switching System
- (7) Section 231-061-010—General Information—Introduction—Network Switching Engineering—No. 1 Electronic Switching System
- (8) Section 231-061-040—Operational Features—2-Wire No. 1 Electronic Switching System
- (9) Section 231-090-366—Feature Document—HILO 4-Wire Switching Feature—2-Wire No. 1 and No. 1A Electronic Switching Systems
- (10) Section 231-090-416—Feature Document—Common Channel Interoffice Signaling—Local and Toll Feature—2-Wire No. 1 and No. 1A Electronic Switching Systems
- (11) Section 231-118-323—Trunk Translation Recent Change Procedures for TG, TGBVT, TRK, CFTRK, and TGMEM (CTX-6 Through 1E5 Generic Programs)—2-Wire No. 1 Electronic Switching System
- (12) Section 231-118-324—Rate and Route Translation Recent Change Procedures for NOCNOG, DNHT, NOGRAC, RATPAT, DIGTRN, TOLDIG, CCOL, RI, CHRGX, DITABS, TNDM, IDDD, and TDXD (CTX-6 through 1E5 Generic Programs)—2-Wire No. 1 Electronic Switching System
- (13) Section 231-118-325—RC Procedures for PSWD, GENT, PSBLK, and SUBTRAN (CTX-6 through 1E5 Generic Programs)—2-Wire No. 1 Electronic Switching System
- (14) Section 231-118-335—Line Recent Change Procedures for LINE, TWOPTY, MPTY, SCLIST, MLHG, ACT, and CFV (CTX-7, CTX-8, 1E4, and 1E5 Generic Programs)—2-Wire No. 1 Electronic Switching System
- (15) Section 231-048-303—CCIS, CFTRK, TG, TGBVT, TGMEM, TKCONV, and TRK Trunk Recent Change Formats (1E6/1AE6 and 1E7/1AE7 Generic Programs)—2-Wire No. 1 and No. 1A Electronic Switching Systems
- (16) Section 231-048-304—ARS, CCOL, CHRGX, DITABS, DIGTRN, DNHT, IDDD, IWSA, NOCNOG, NOGRAC, RATPAT, RI, RLST, TDXD, and TNDM Rate and Route Recent Change Formats (1E6/1AE6 and 1E7/1AE7 Generic Programs)—2-Wire No. 1 and No. 1A Electronic Switching Systems
- (17) Section 231-048-305—GENT, PSBLK, PSWD, and SUBTRAN Recent Change Formats (1E6/1AE6 and 1E7/1AE7 Generic Programs)—2-Wire No. 1 and No. 1A Electronic Switching Systems
- (18) Section 231-048-312—ACT, CFV, LINE, MLHG, MOVE, MPTY, OBS, SCLIST, SIMFAC, TWOPTY, and VSS Line Recent Change Formats (1E6/1AE6 and 1E7/1AE7 Generic Programs)—2-Wire No. 1 and No. 1A Electronic Switching Systems
- (19) Section 966-100-100—General Description—2-Wire No. 1 Electronic Switching System
- (20) Section 231-032-025—Remote Trunk Test Unit—Description—2-Wire No. 1 and No. 1A Electronic Switching Systems
- (21) Section 231-045-235—Trunk and Line Test—Software Description—2-Wire No. 1 and No. 1A Electronic Switching Systems
- (22) Section 824-101-118—Operations Support Systems Remote Trunk Test Frame (RTTF)—Transmission Measuring Equipment and Design Requirements
- (23) Section 824-101-124—Operations Support Systems—Central Trunk Test Unit—Transmission—Equipment Design Requirements
- (24) Section 865-205-100—Operations Support Systems, Remote Trunk Test Frame/Central Trunk Test Unit (RTTF/CTTU)—Engineering Implementation Methods—Systems and SCC TMP Engineering Considerations.

B. Teletypewriter Input and Output Manuals

- (1) Input Message Manual IM-1A001—2-Wire No. 1 Electronic Switching System
- (2) Output Message Manual OM-1A001—2-Wire No. 1 Electronic Switching System.

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C. Other Documentation

- (1) Translation Guide TG-1A—No. 1 and No. 1A Electronic Switching Systems—2-Wire
- (2) Office Parameter Specification PA-591001—No. 1 Electronic Switching System—2-Wire
- (3) Parameter Guide PG-1—No. 1 Electronic Switching System—2-Wire
- (4) Translation Output Configuration PA-591003—No. 1 Electronic Switching System—2-Wire
- (5) OPD-1P032-01—Operations Support Systems Remote Trunk Test Frame/Central Trunk Test Unit (RTTF/CTTU)—Overall System Description
- (6) OPD-1P032-02—Operations Support Systems Remote Trunk Test Frame (RTTF) System Description—2-Wire No. 1/1A and No. 2/2B ESS
- (7) OPP-1P032-01—Operations Support Systems Remote Trunk Test Frame/Central Trunk Test Unit (RTTF/CTTU)—Performance Test Requirements
- (8) OPO-1P032-01—Operations Support Systems Central Trunk Test Unit (CCTU)—Methods of Operations
- (9) OPM-1P032-01—Operations Support Systems Remote Trunk Test Frame/Central Trunk Test Unit (RTTF/CTTU)—Overall System Maintenance and Tests
- (10) OPM-1P032-02—Operations Support Systems Remote Trunk Test Frame (RTTF)—Maintenance and Trouble Locating Procedures—2-Wire No. 1/1A ESS
- (11) BISP 759-100-000—Subject Index—Central Office Equipment Engineering System (COEES)
- (12) BISP 759-100-100—General Description—Central Office Equipment Engineering System (COEES).◆

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Introduction to the Nortel FMT-150 System

FMT-150 Introduction

The Fiber Multiplex Terminal (FMT) system was designed as a small to medium capacity optical transmission media. It incorporates the newest means of system maintenance and operational capabilities. (Refer to Figure 1)

FMT-150B/C/D System

The FMT-150B/C/D system is actually a combination of successful Northern Telecom products developed in response to the ever-changing requirements of the telecommunications industry. The product architecture supports such applications as subscriber loops, inter-office links, hub configurations, drop/insert configurations, and features an overhead transmission capacity for ease of operation and maintenance.

The FMT-150B/C/D is capable of combining mixtures of DS-1, DS-1C, and DS-2 data streams into an optical DS-3 output, while providing sophisticated surveillance and protection basis.

The FMT-150B/C/D fiber optic transmission system combines DM-13 multiplexers and 150 Mbps Fiber Transports (FT) in compact transmission capacity for ease of operation and maintenance on a network oriented basis.

The FMT-150 family consists of three products: (Refer to Figure 2)

- FMT-150B – a single shelf unit which consists of a digital multiplexer/demultiplexer and a 150 Mbps fiber optic interface module.
- FMT-150C – a single shelf unit which consists of two digital multiplexer/demultiplexers.
- FMT-150D – a single shelf unit used for regenerating fiber optic signals which consists of two 150 Mbps fiber optic interface sections.

Although the FMT-150B, FMT-150C, and FMT-150D are three different shelves, they are all composed of two basic building blocks:

- The DM-13 multiplexer.
- The 150 Mbps fiber interface.

Each FMT-150B/C/D system contains the following items:

FMT-150B Shelf:

- One DM-13 digital multiplexer/demultiplexer.
- One 150 Mbps fiber optic interface module for unprotected configuration, or two for optional 1 + 1 protection.
- Two power supply units for unprotected configuration, or four for optional 1 + 1 protection.
- Maintenance Control Unit (MCU) for alarm and control processing.
- Service Channel Unit (SCU) providing voice communication between terminal sites (optional).

FMT-150C Shelf:

- Two DM-13 digital multiplexer/demultiplexers.
- Two power supply units for unprotected configuration, or four for optional 1 + 1 protection.

FMT–150D Shelf:

- Two 150 Mbps fiber optic interface modules for unprotected configuration, or four for optional 1 + 1 protection.
- Two power supply units for unprotected configuration, or four for optional 1 + 1 protection.
- Two Maintenance Control Unit (MCU) for alarm and control processing.
- Service Channel Unit (SCU) providing voice communication between terminal sites (optional).

Designed for Growth

All aspects of the FMT–150 system are designed to allow for easy growth as the user's circuit requirements change. For example, a customer could install a FMT–150 system carrying only a few DS–1 signals, with the rest of the interface board wired out to unused cross–connect panels. Later, the customer could add in more circuit packs (i.e., DS–1 circuits or, depending on need, add DS–1C or DS–2 circuits instead). Note that the configuration of the cable interface board is determined by the type of circuit being installed and must be wired accordingly.

Signal Flow

Transmission Capacity

The groups of a DM–13 multiplexer may consist of any combination of four DS–1, two DS–1C, or one DS–2 line tributary that result in an aggregate bit rate of 44.736 Mbps (the DS–3 bit rate). This is then handled by one 150 Mbps fiber interface module. Maximum capacities are as follows: (*Refer to Figure 3*)

- 28 DS–1 tributaries (24 voice channels).
- 14 DS–1C tributaries (48 voice channels).
- 7 DS–2 tributaries (96 voice channels).
- Any combination of the above in which the bit rate is less than or equal to 44.736 Mbps.

A FMT–150C shelf can multiplex twice the maximum of an FMT–150B thus producing two DS–3 signals.

A FMT–150B used in conjunction with a FMT–150C can multiplex a total of three DS–3 signals.

Examples of other arrangements meeting the maximum capacity of the DM–13 are as follows:

- 24 DS–1 and 1 DS–2 tributaries.
- 16 DS–1 and 3 DS–2 tributaries.
- 16 DS–1, 2 DS–1C, and 2 DS–2 tributaries.
- 4 DS–1C and 5 DS–2 tributaries.

Signaling

The FMT–150B & C architecture distinguishes between types of signaling:

- Optical
- Translator (STX)
- High–speed
- Low–speed

In this terminology, optical signaling refers to the 149.76 Mbps optical signal rate and the STX refers to the Northern Telecom defined electrical signal containing the DS–3 payload information and overhead bit structure within a 49.92 Mbps signal rate. High–speed refers to the DS–3 rate (44.736 Mbps) and is limited to the DM–13 groups and tributaries at the DS–1, DS–1C or DS–2 rate (1.544 Mbps, 3.152 Mbps and 6.132 Mbps respectively).

Multiplexing

Multiplexing between low-speed signals (DS-1, DS-1C, and DS-2) and the high-speed signal is accomplished in two stages. In the first stage of multiplexing, the low-speed signals are synchronized into seven groups at the DS-2 signal rate. This is performed by DS-1, DS-1C, and DS-2 Tx/Rx modules. Also, this stage converts the signals from bipolar to unipolar format. The second stage of multiplexing organizes the seven groups into a single DS-3 digital signal, which is again bipolar. Each of the seven groups at the DS-2 rate may be composed of one DS-2, two DS-1C, or four DS-1 signals. Lastly, the electrical DS-3 signal is converted into an optical signal for transmission over optical fibers.

150 Mbps Fiber Transport

The 150 Mbps interface can receive up to 3 incoming DS-3 signals from the DM-13 multiplexers (or other DS-3 sources). In the transmit direction, each DS-3 signal is translated to a STX signal (49.92 Mbps). The overhead bits in the STX signal carry alarm, maintenance, and service channel information for the network. The signal processing, (and that for the opposite direction) is performed within the DS-3 translator module. There is one working translator and one standby translator per DS-3 signal. The three 49.92 Mbps signals are multiplexed together within the 150 Mbps optical Tx/Rx module to generate a single electrical signal with a line rate of 149.76 Mbps. The electrical signal is then converted into an optical equivalent for transmission over fiber optical cables. In the receive direction, an incoming 149.76 Mbps optical signal is converted to its electrical form and then demultiplexed to 3 STX signals. The signals are then routed to the appropriate translator module where each 49.92 Mbps signal is split into a DS-3 signal (44.736 Mbps) and corresponding overhead. The overhead containing the network information is fed to the Service Channel Unit (SCU) and Maintenance Control Unit (MCU) for processing. (Refer to Figure 4)

Configuration

Maintenance Control Unit

Each FMT-150 node is equipped with one Maintenance Control Unit (MCU). The MCU provides monitoring and performance control for the FMT-150 node. Monitoring and control is provided for the 150 Mbps fiber interface, up to three associated DM-13 multiplexers, one (optional) Service Channel Unit (for voice data) and all associated power supply units. The MCU gathers and process alarm information for transmission throughout the network. This gathered information is carried in the overhead of the 49.92 Mbps signal. Control commands sent to the node from the CRT interface are also carried in the 49.92 Mbps overhead and are processed by the MCU at the appropriate node.

Note: A "node" is defined as any place in the FMT-150 network where a MCU is located. The maximum number of nodes allowed in a FMT-150 network is 16.

Service Channel Unit

The FMT-150 B & D shelves can be fitted with a Service Channel Unit (SCU) which provides voice/data communication through the overhead. Two voice channels per DS-3 signal are provided: one *Local Order* wire channel, and one *Express Order* wire channel. Local Order wire accesses all sites common to a DS-3 signal. The Express Order wire accesses only *Terminal* sites common to a DS-3 signal. The Express and Local Order wires are accessible via a jack at the front panel of the shelf.

Each site in a FMT-150 network may be individually addressed using DIP switches on the SCU. Sites are accessed by dialing a 4-digit number from a handset/headset.

The SCU also provides customer input and output points. These are used to retrieve status and alarm information not only from the FMT-150, but also from any other external equipment desired. The NT7H75BA version of the SCU support 12 customer inputs and 4 customer outputs. The NT7H75BB version supports 8 inputs and 16 outputs.

Power Supply Unit

Each FMT-150 shelf is equipped with four power supply units which convert either -48V or -24V to +5/-5 Volts which is used for the entire shelf. Power supply units are monitored by the MCU for proper operation. A failure with a power supply unit is displayed on the CRT interface unit for quick and simple detection.

CRT Interface

The MCU supports control and monitoring of an FMT-150 network through a CRT interface. The CRT allows the user to display the network status, and any alarm that exist. Control over remote sites (e.g., force switch, loopback, etc.) can be implemented through commands entered at the CRT terminal. The software accepts commands entered by the user at the keyboard and responds by displaying information concerning alarms, status, control, and maintenance information on the CRT screen. The interface may operate at 300, 1200, 2400, or 9600 baud rates.

Protection

The FMT-150B/C/D provides low-level and high-level automatic switching. Low-level includes low-speed (DS-1, DS-1C, and/or DS-2 rate) automatic protection switching, while the high-level includes both high-speed (DS-3 rate), and translator (STX rate) automatic protection switching. The DS-1, DS-1C, DS-2, DS-3, and STX protection switches all operate independently.

DM-13 Multiplexer:

DS-1 Tx/Rx Module : 1:N (where N = 1-7)
DS-1C Tx/Rx Module : 1:N (where N = 1-7)
DS-2 Tx/Rx Module : 1:N (where N = 1-7)
DS-3 Tx/Rx Module : 1 + 1

150 Mbps Fiber Transport:

DS-3 Translator : 1 + 1
Optical Tx/Rx Unit : 1 + 1

Common Equipment:

Power Supply Unit : 1 + 1

Modes of Operation

The DM-13 can be configured for either: (Refer to Figure 5)

- Terminal Operation
- Drop/Insert Operation

The essential differences between the two modes of operation are in the low-speed stage of multiplexing. In *Terminal* mode, all DS-2 groups are demultiplexed to their composite low-speed signals. In *Drop/Insert* operation the low-speed signals do not have to be demultiplexed past the DS-2 line.

Terminal operation is generally required at sites where the DS-3 signals are terminated. In this case, the equipment is configured for bi-directional signal processing. *Drop/Insert* is required at intermediate sites where DS-3 signals must be accessed for information (either in whole or at lower bit rates). In *Drop/Insert* configurations, typically twice as much transmission equipment is required due to the uni-directional configuration.

In *Terminal* operation for the DM-13, all low-speed groups are demultiplexed from a DS-3 to their respective low-speed bit rates. The low-speed signals are then accessed for further processing. In *Drop/Insert* configurations, some of the low-speed tributaries within a DS-3 are not required at the location and must be "looped-through" the site. This is accomplished by using a special "loop-thru" module which is available for this process. This eliminates hard patch requirements. The tributaries are looped through at the 6.312 Mbps unipolar line rate. Looped through groups have their signals looped directly back into the multiplexer process. Typically, DM-13 *Terminal* configurations require one bi-directional DM-13, while *Drop/Insert* locations require one DM-13 per direction. (Refer to Figure 6)

Site Configurations

The FMT-150B/C/D shelves can be arranged together to form several types of site configurations:

- Terminal
- Drop/Insert
- Repeater
- Hub

Terminal Site

A *Terminal* site combines up to three DM-13 multiplexers with one 150 Mbps fiber interface. This could be formed with one FMT-150B shelf and one FMT-150C shelf, as shown in Figure 7.

Note: The FMT-150B has two independent signal processing units, the multiplexer and fiber interface units. Therefore, the FMT-150B shelf may be fed any mix of DS-3s from other external sources (i.e., radio products, existing DMT-300 sources, etc.).

Drop/Insert Site

A *Drop/Insert* site combines two 150 Mbps fiber interfaces with various combinations of DM-13 multiplexers. Each 150 Mbps interface (and any assorted multiplexer equipment) processes the signals for one direction. An example using two DM-13s can be derived from two FMT-150B shelves as shown in Figure 8. Note that this could also be done with one FMT-150C shelf and one FMT-150D shelf since the shelves in either configuration are functionally identical.

Repeater Site

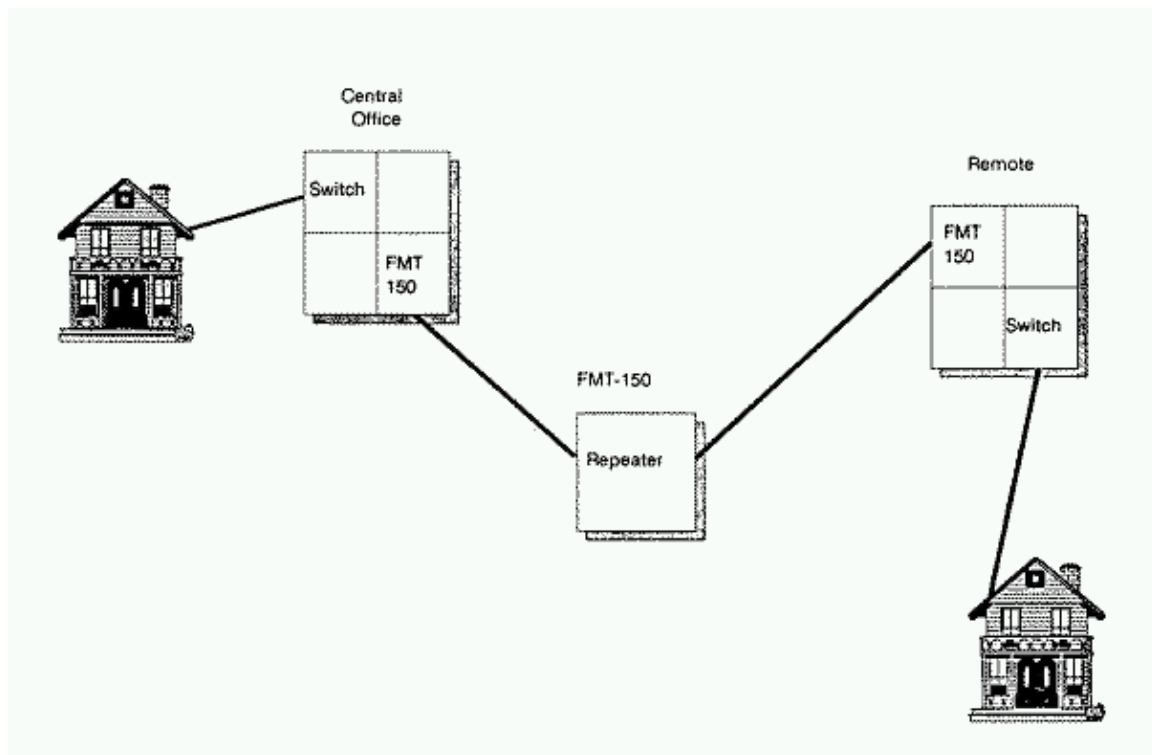
A *Repeater* site combines two 150 Mbps fiber interfaces that serve to regenerate the optical signal for further transmission. Such a site could be formed from a single FMT-150D shelf, as shown in *Figure 9*.

Hub Site

A *Hub* site combines optical interfaces that enable us to route the DS-3 signals in different directions. This is done without the use of extra multiplexers. Therefore, the signal does not have to be broken down to the DS-1 level, as shown in *Figure 10*.

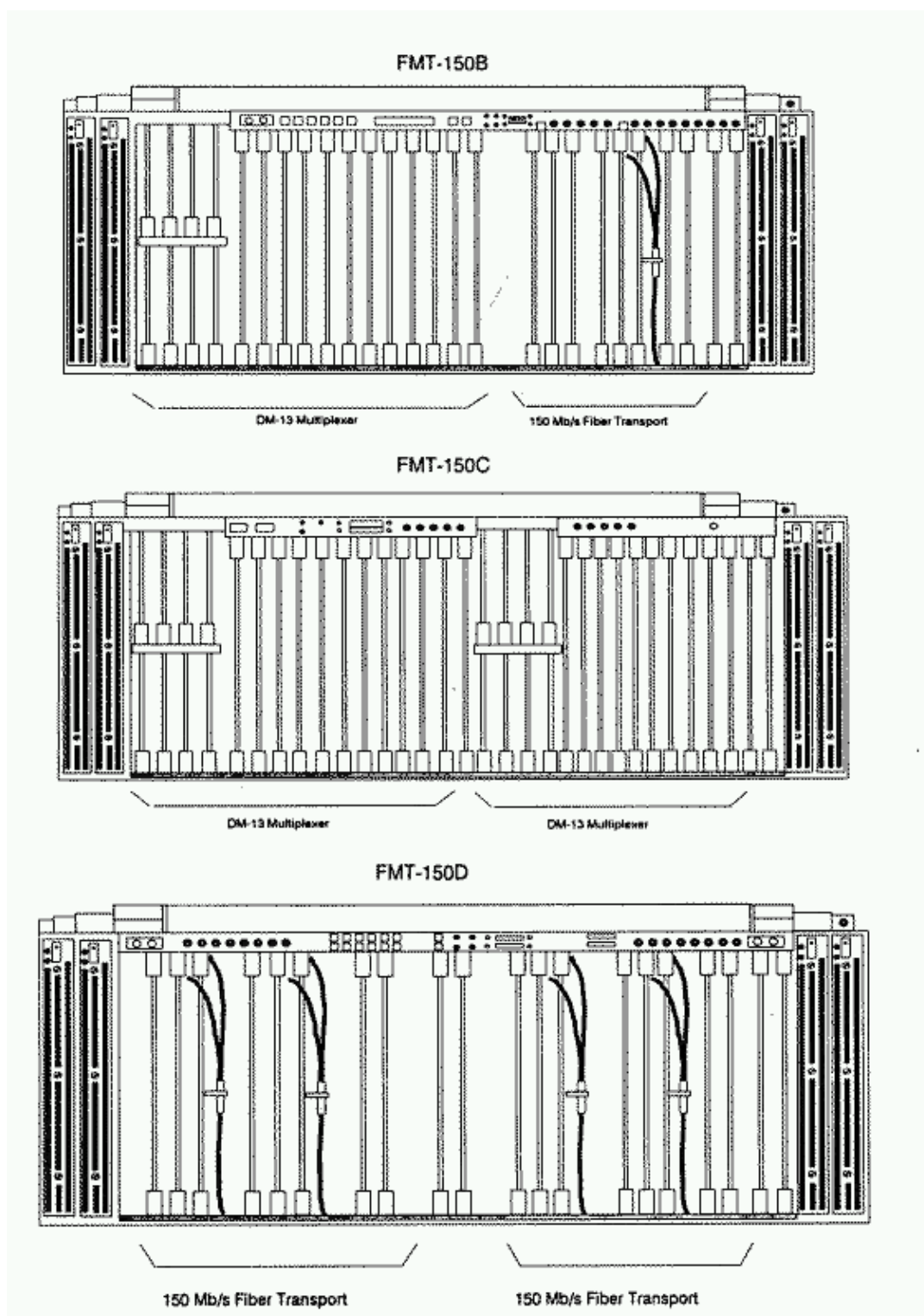
Introduction to the Nortel FMT-150 System

Figure 1



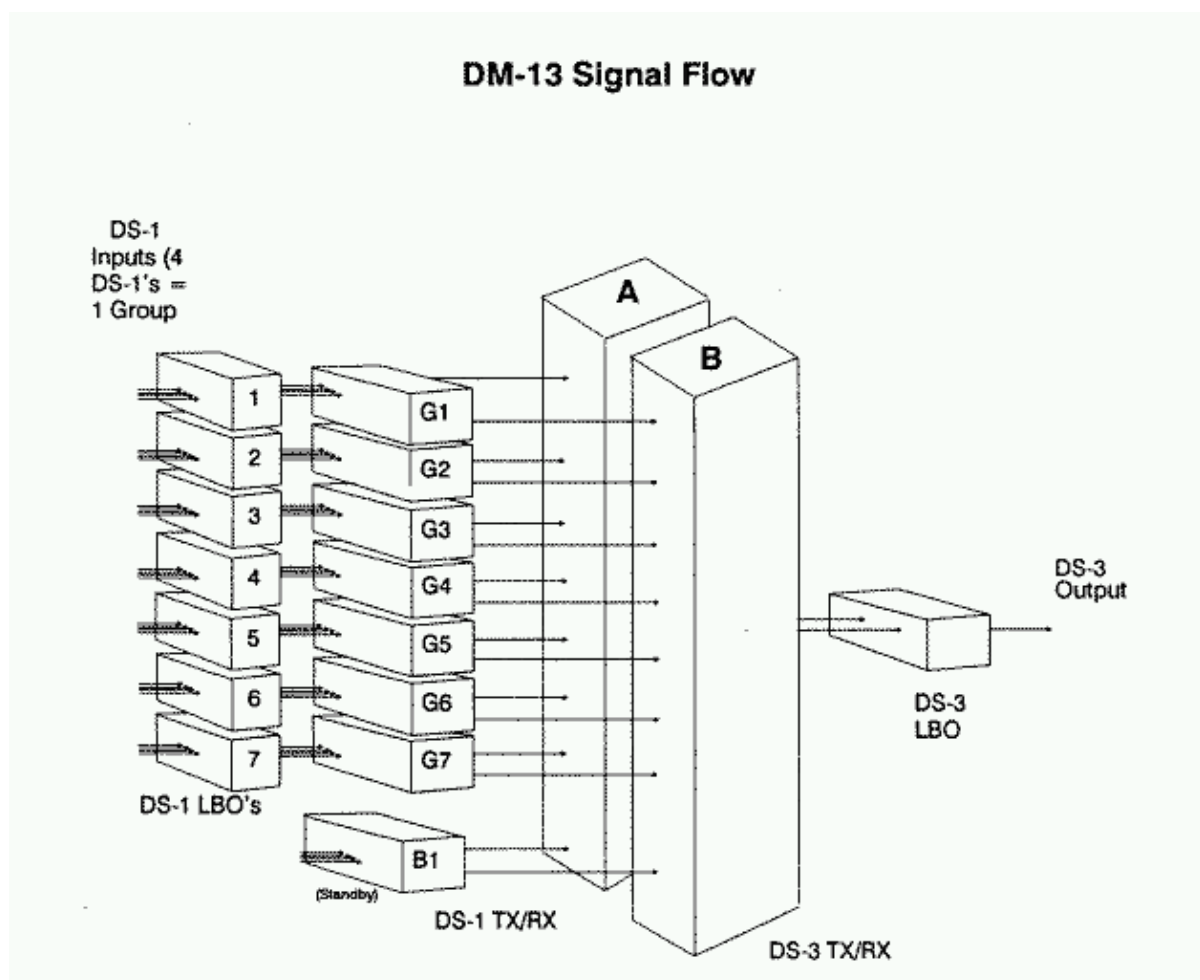
Introduction to the Nortel FMT-150 System

Figure 2



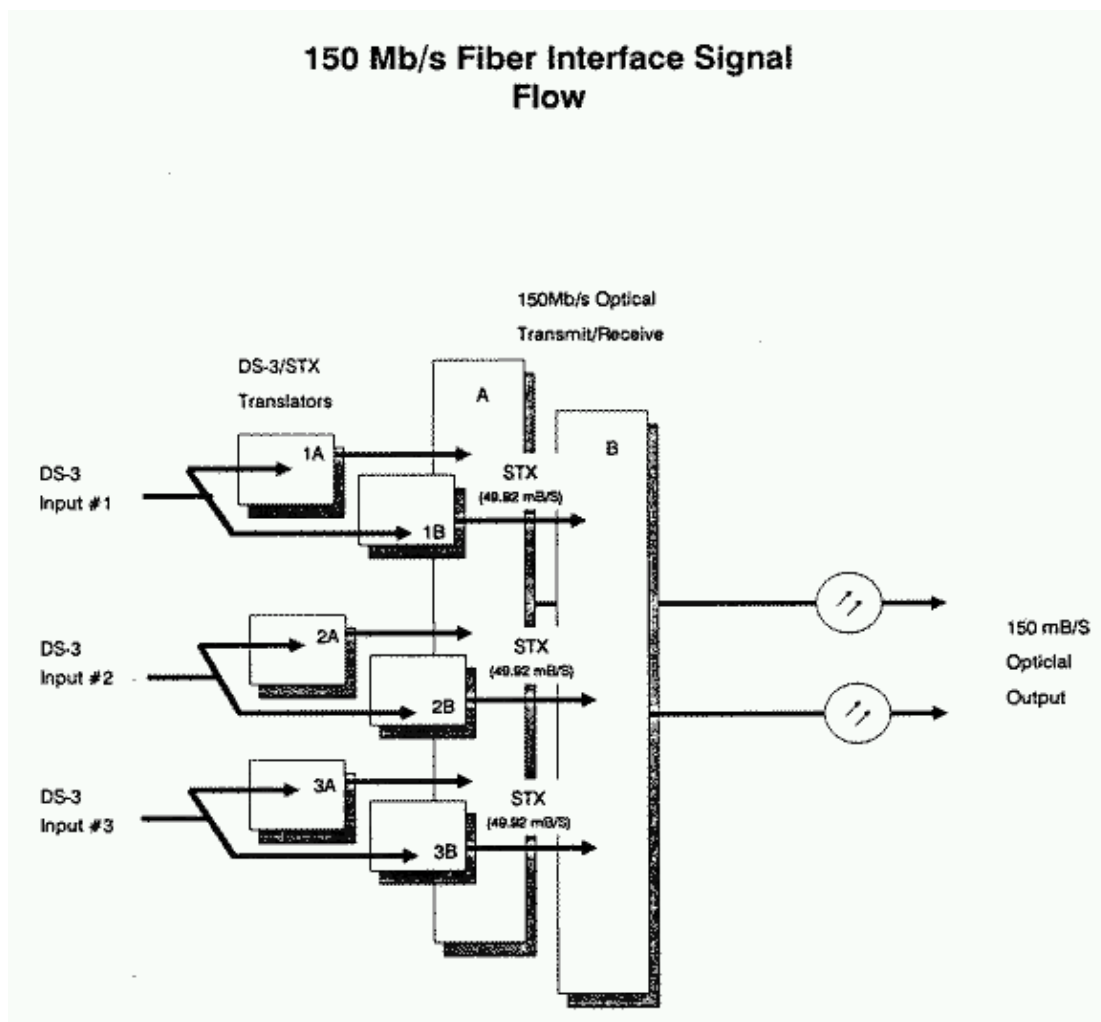
Introduction to the Nortel FMT-150 System

Figure 3



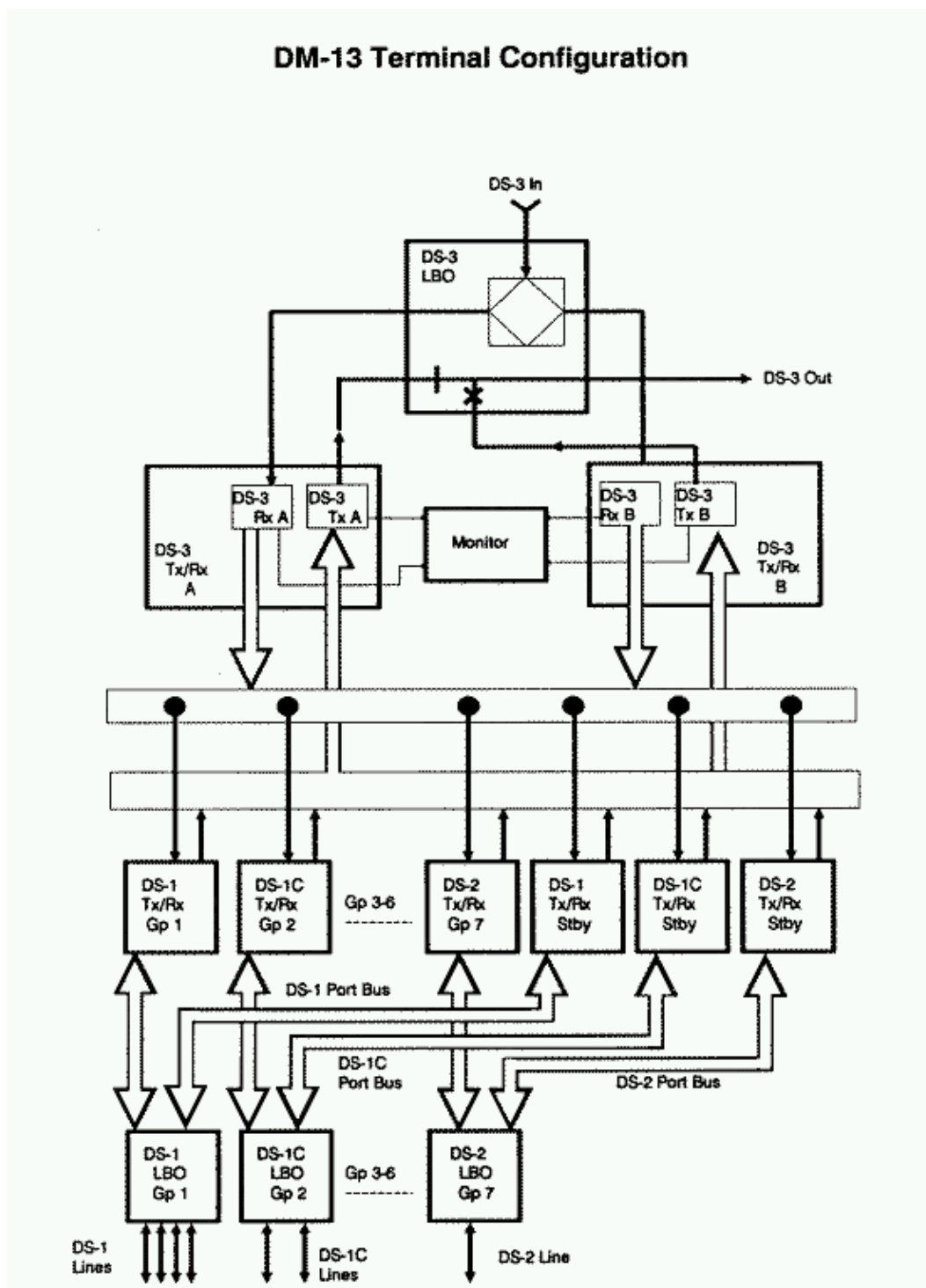
Introduction to the Nortel FMT-150 System

Figure 4



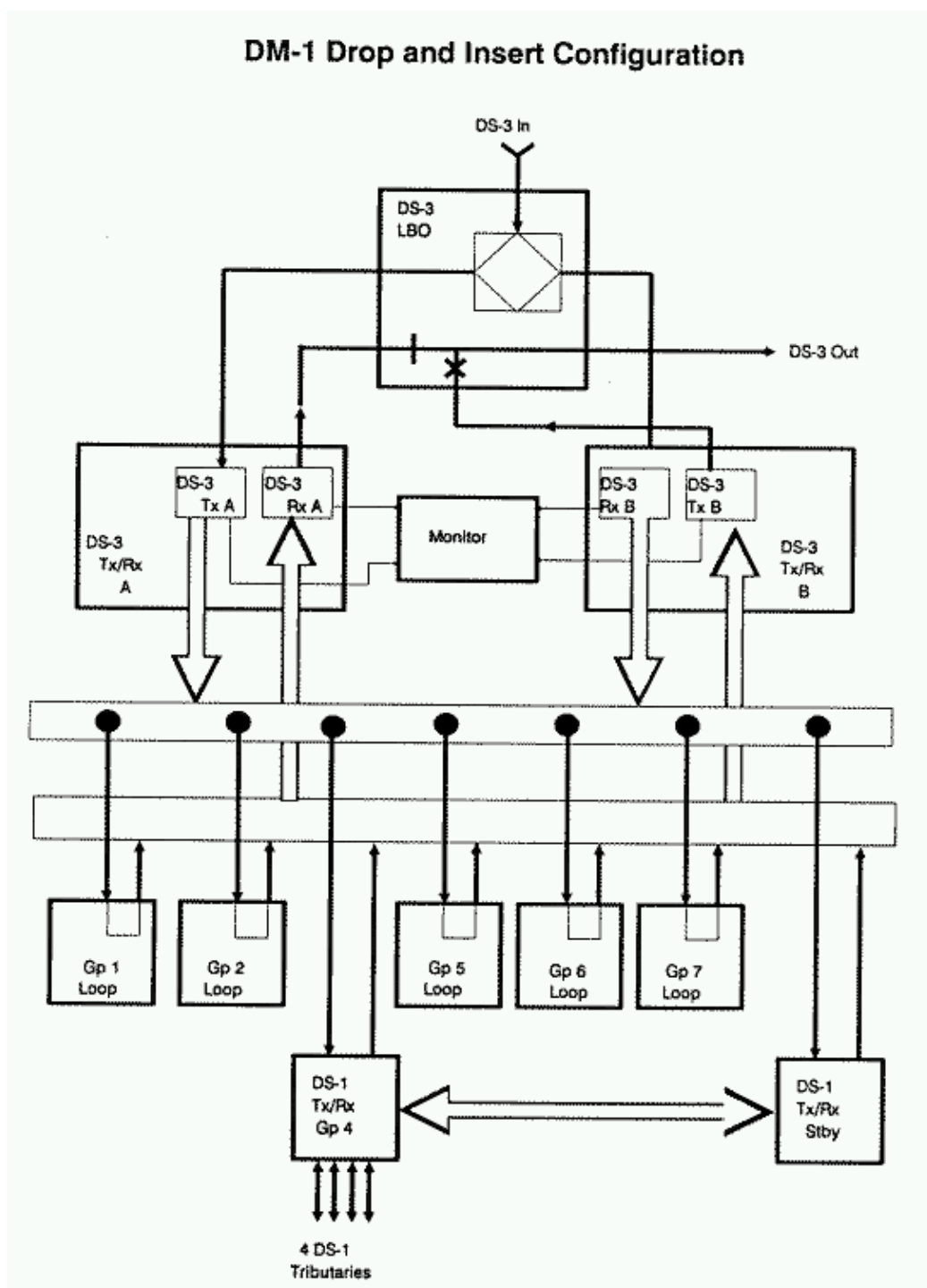
Introduction to the Nortel FMT-150 System

Figure 5



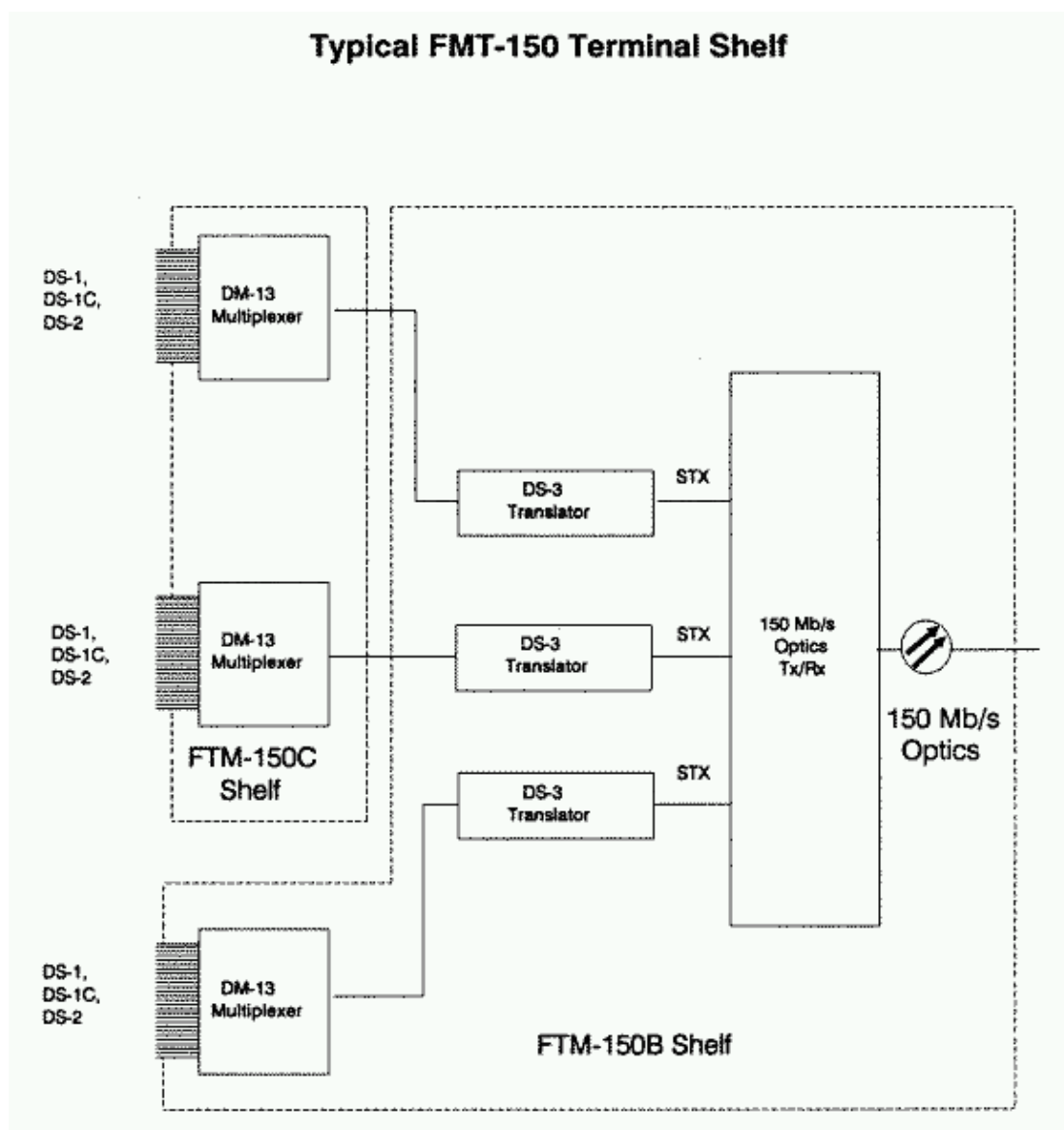
Introduction to the Nortel FMT-150 System

Figure 6



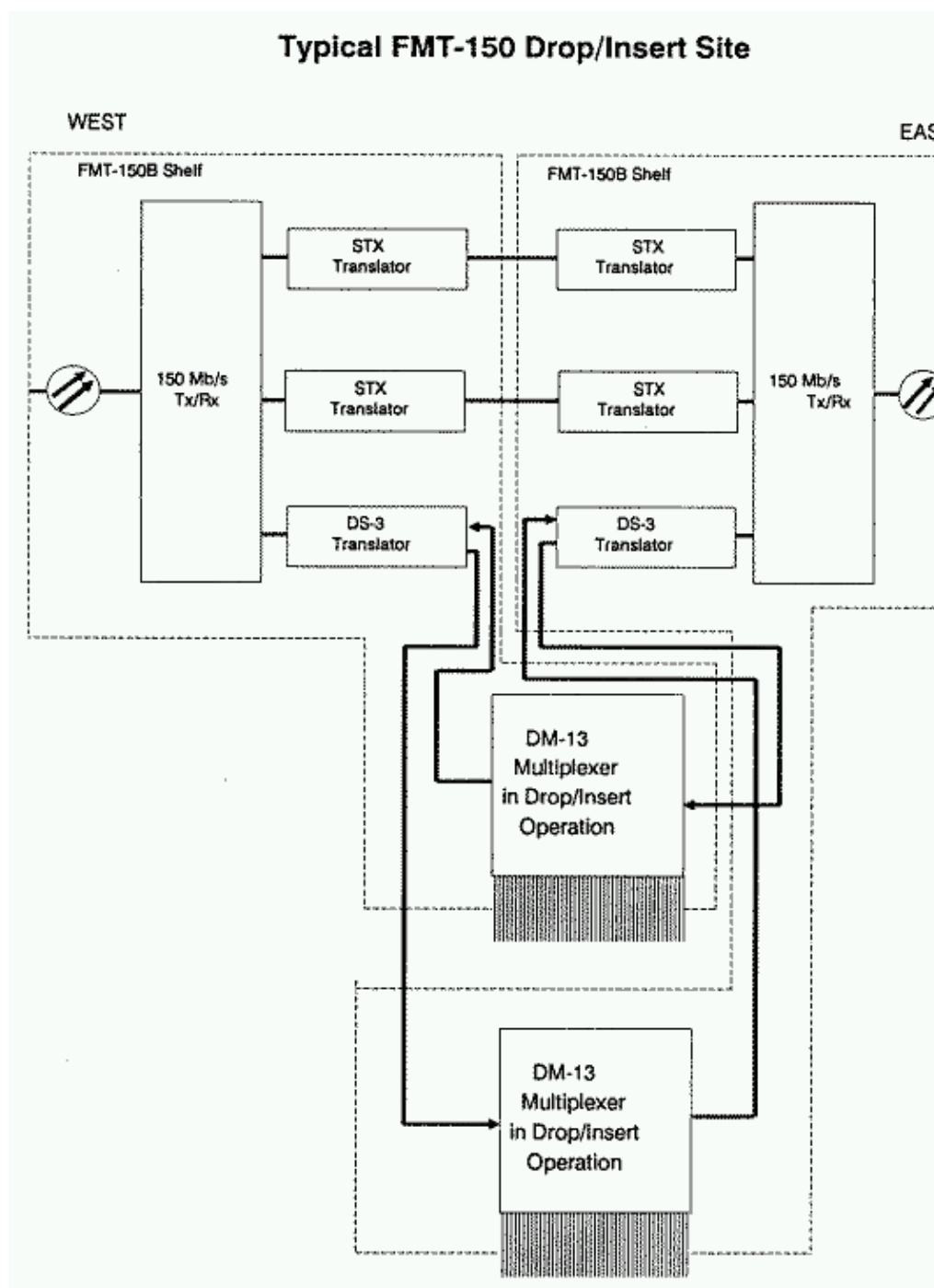
Introduction to the Nortel FMT-150 System

Figure 7



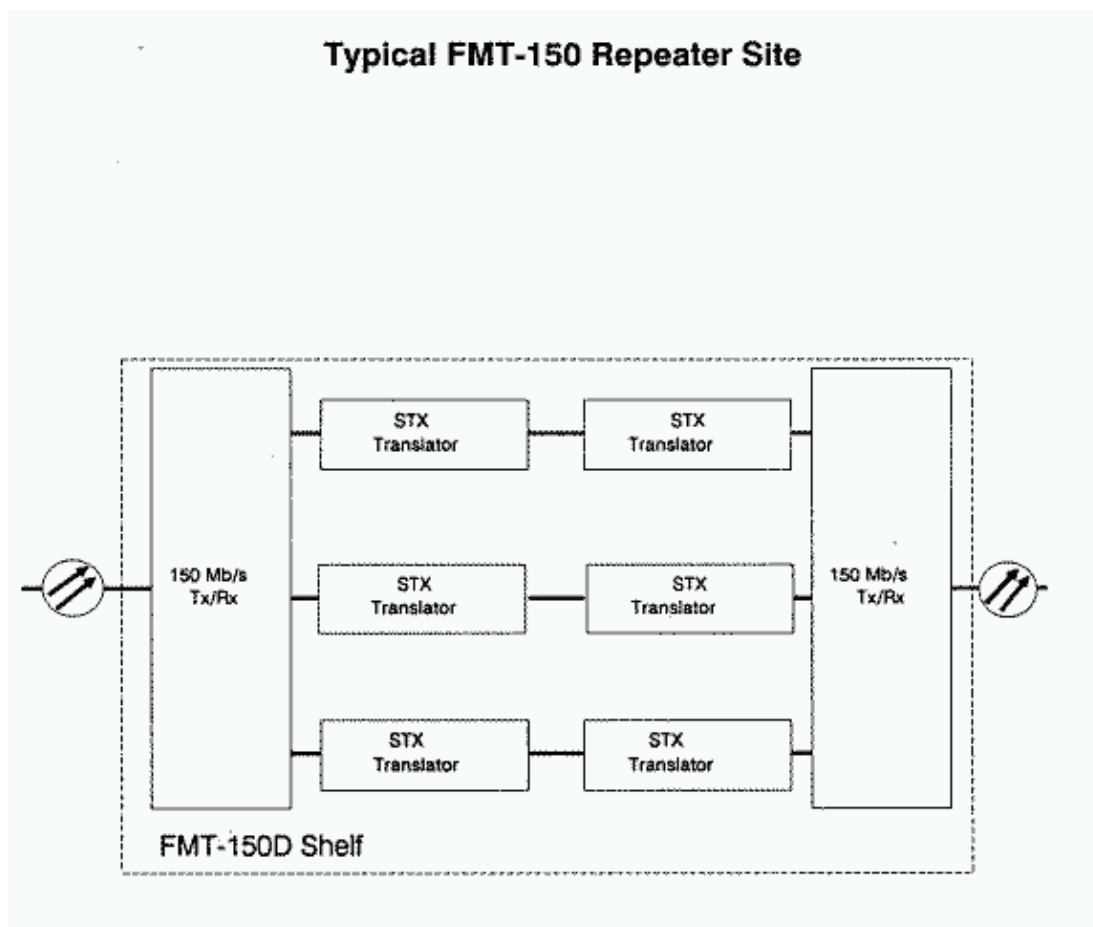
Introduction to the Nortel FMT-150 System

Figure 8



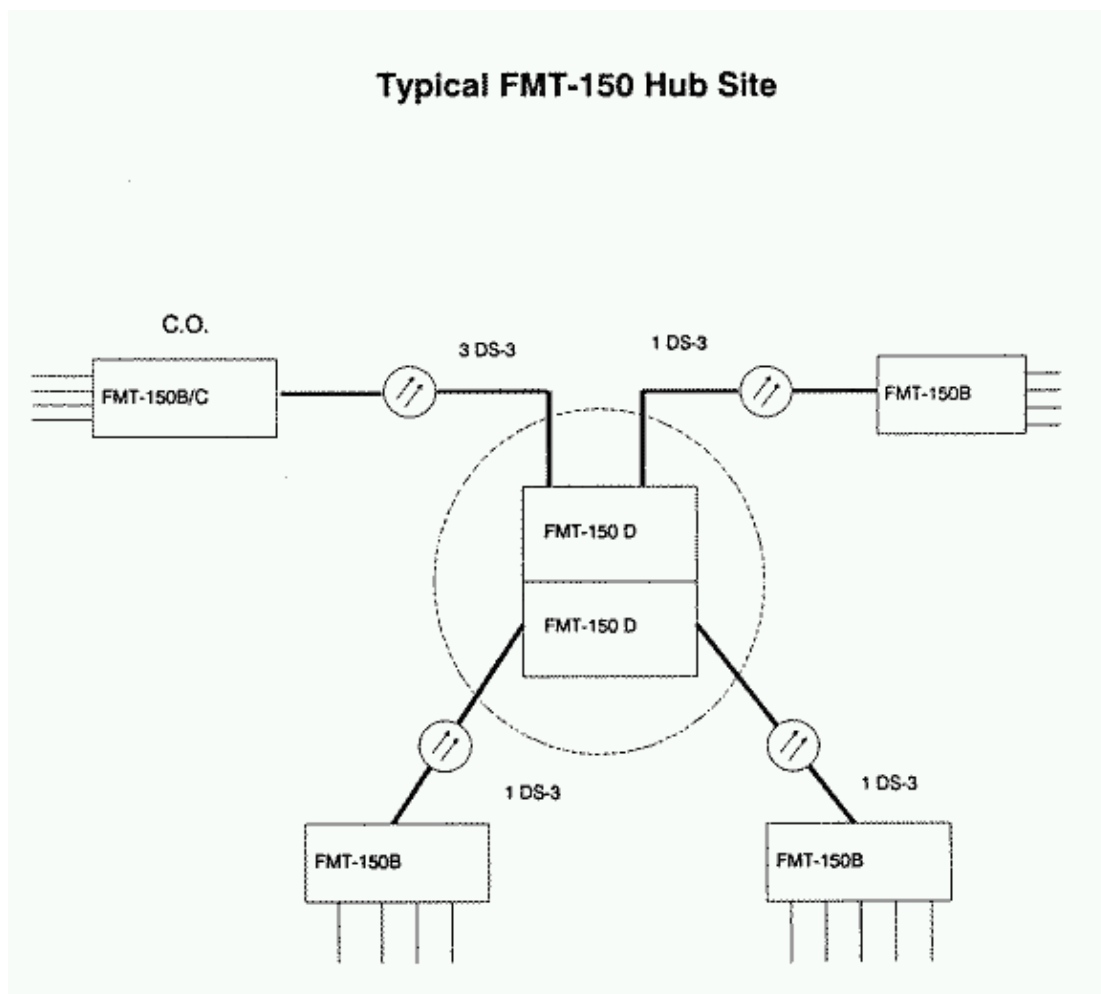
Introduction to the Nortel FMT-150 System

Figure 9



Introduction to the Nortel FMT-150 System

Figure 10



Remote Control for a PRO-2042 Scanner

Overview

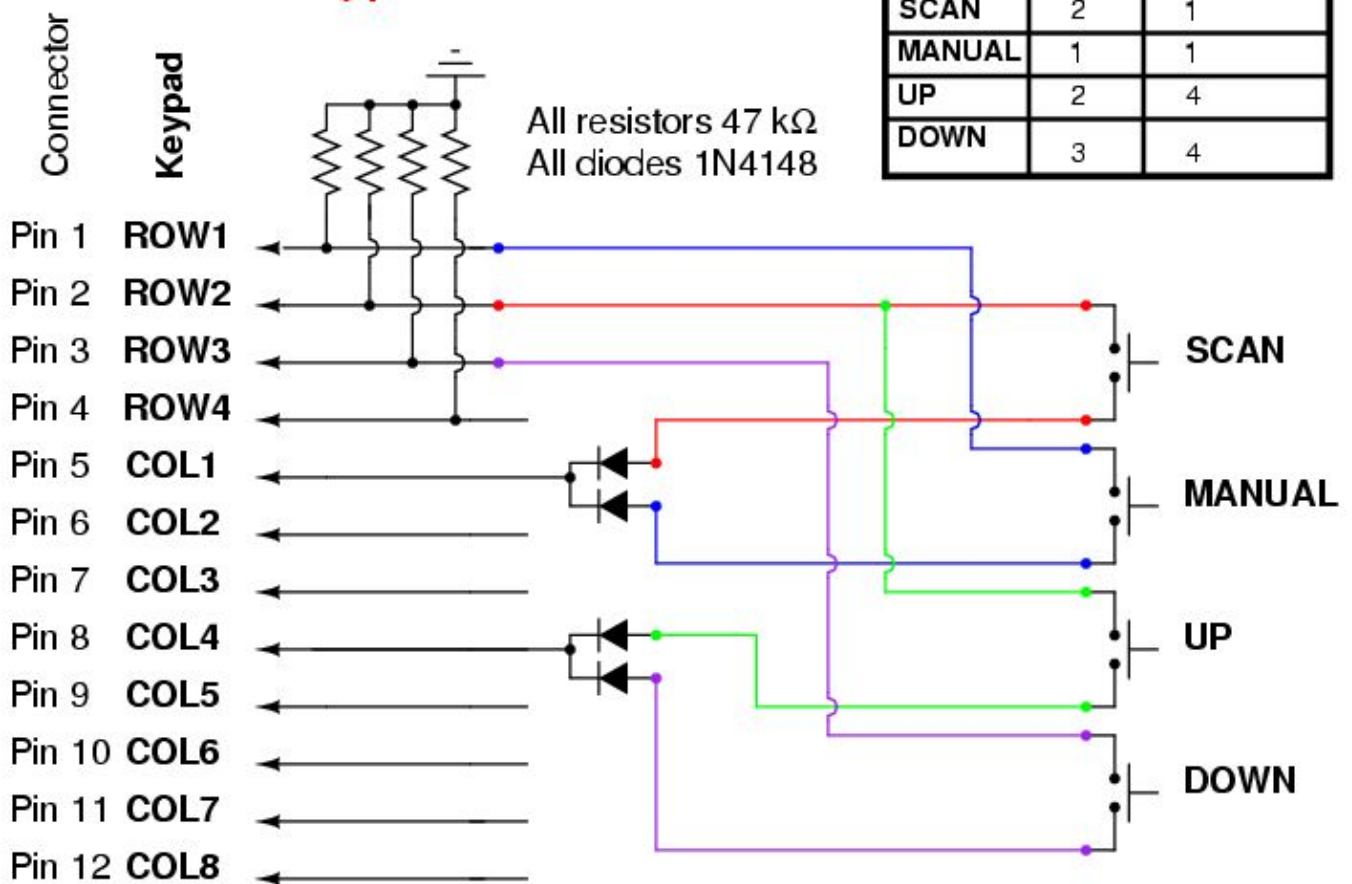
This is a simple little hack to extend a few of the keypad buttons on a Radio Shack PRO-2042 scanner. This will allow a person to activate a button on the scanner remotely, without having to be anywhere near the scanner. This is very useful for those crowded SIGINT environments where you may have a lot of radios going, and you don't want to get up all-the-time to press a "SCAN" button.

This example remote is for the Radio Shack PRO-2042/PRO-2035-series of scanners *only*. Other Radio Shack models will have a similar keypad interface. The keypad schematic for a Radio Shack PRO-2006/PRO-2005/PRO-2004-series scanner will be posted at the end of the article.

The actual remote hardware is quite simple. All you need is four 47k resistors, some 1N4148 or 1N914 diodes, push button switches (normally open), wire (8-conductor CAT-3 is best), and some male/female DB-25 connectors.

Schematic

Radio Shack PRO-2042/PRO-2035 Front-Panel Keypad Connections



Operation

The remote's operation is quite simple. It's just the scanner's keypad signals routed to an external push button. The resistor and diodes are for isolating the signals from the other keys. Each wire going to a *column* (COL) line needs a series isolating diode. This is very important for isolating each of the keys. Look at the schematic to see an example of multiple wires going to a single column. The *row* (ROW) lines each only need a single 47k resistor to ground.

Example: If you want to extend the **SCAN** button on a PRO-2042 scanner, you need to connect both the **ROW2** (pin-2 on the PRO-2042's front-panel keypad connector) and the **COL1** line (pin-5 on the PRO-2042's front-panel keypad connector). These can be connected together via a simple push button switch.

PRO-2042/PRO-2035 Keypad Matrix

The numbers in parentheses () are the pin numbers on the front-panel keypad connector. That large, white 15-pin connector behind the scanner's front-panel. It's labeled CN501 or CN503.

	COL1 (5)	COL2 (6)	COL3 (7)	COL4 (8)	COL5 (9)	COL6 (10)	COL7 (11)	COL8 (12)
ROW1 (1)	MAN	AUTO	RECT	LIMIT	PRI	1	2	3
ROW2 (2)	SCAN	PGM	L/OUT	UP	MODE	4	5	6
ROW3 (3)	TUNE	TX	L/OUTRV	DWN	STEP	7	8	9
ROW4 (4)	SNDSQ	ENT	DEL	MON	RESET	0	.	CLEAR

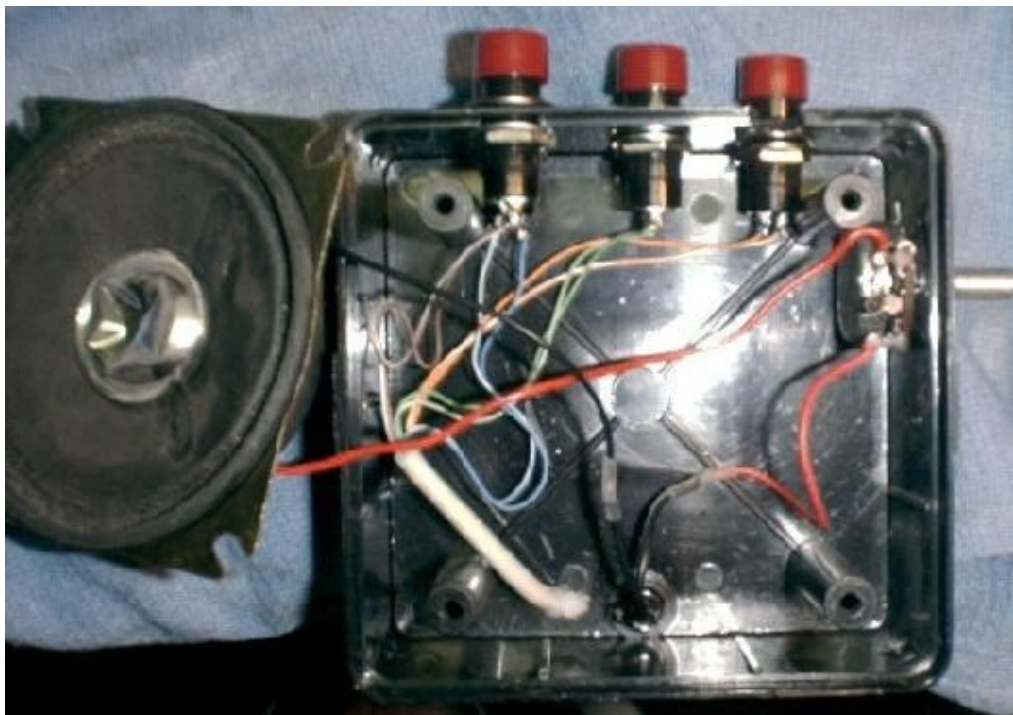
Example: If you want to extend the **MODE** button on a PRO-2042 scanner, you need to connect both the **ROW2** (pin-2 on the PRO-2042's front-panel keypad connector) and the **COL5** line (pin-9 on the PRO-2042's front-panel keypad connector).

Pictures



Picture of a Radio Shack external speaker (Part Number 21-549A) which contains the remote control's **SCAN**, **MANUAL**, **UP**, and **DOWN** buttons. A 100 ohm potentiometer is mounted on the side of the speaker for use as a secondary volume control. (Wire it like a variable resistor, in series with the speaker's + lead). A male DB-25 connector and the speaker's 1/8" plug are shown on the bottom left (they come out the back of the speaker). These connect to the PRO-2042 scanner via about eight feet of cable.

(Don't be a dumbass and break the plastic when drilling...)



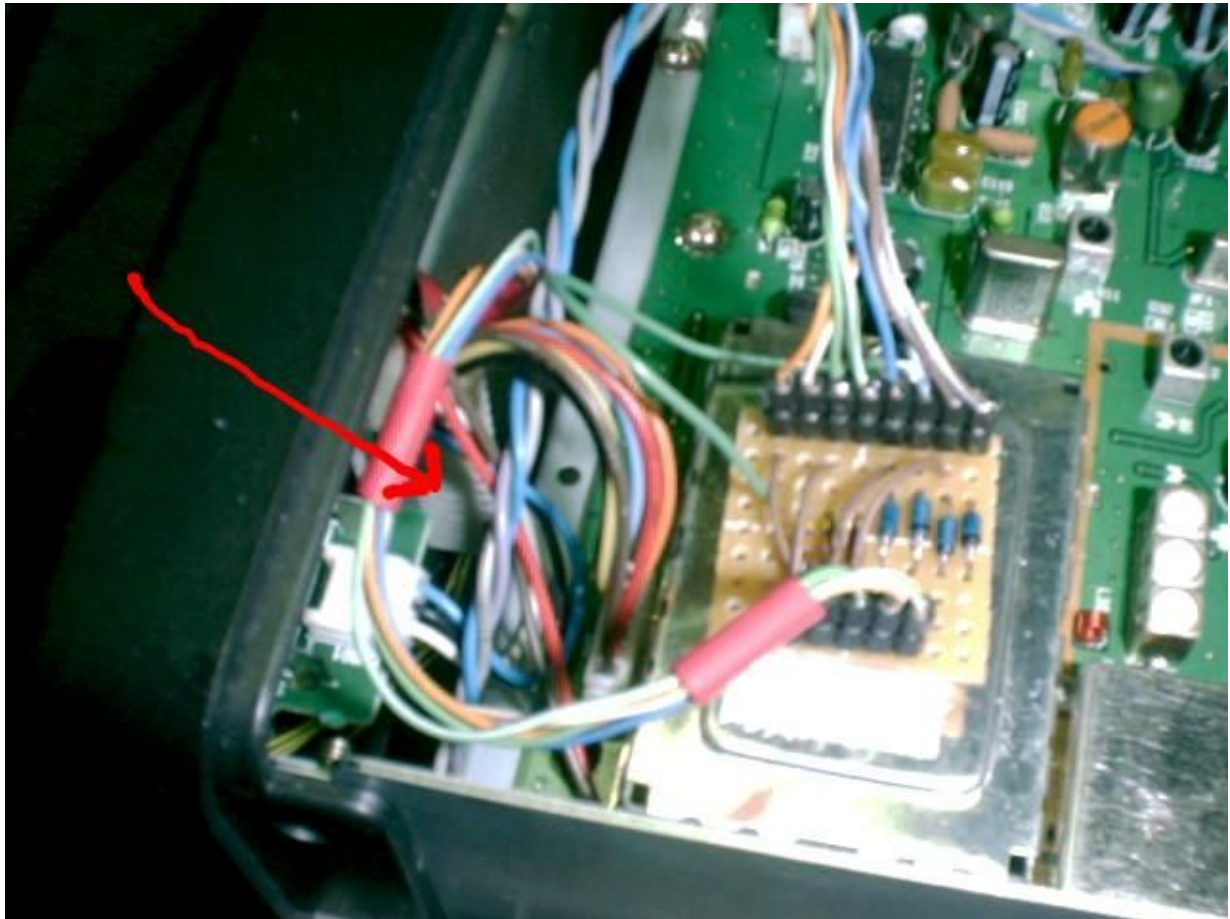
Internal speaker picture showing the incoming wiring (bottom) for the four push buttons and the volume potentiometer (right).



Close-up internal view of the speaker. The big RED wire is the speaker's positive (+) lead.



Internal view of the PRO-2042 scanner. The resistor/diode interface network is on the lower left. It routes, via SIP sockets, to a female DB-25 connector coming out the back of the scanner.

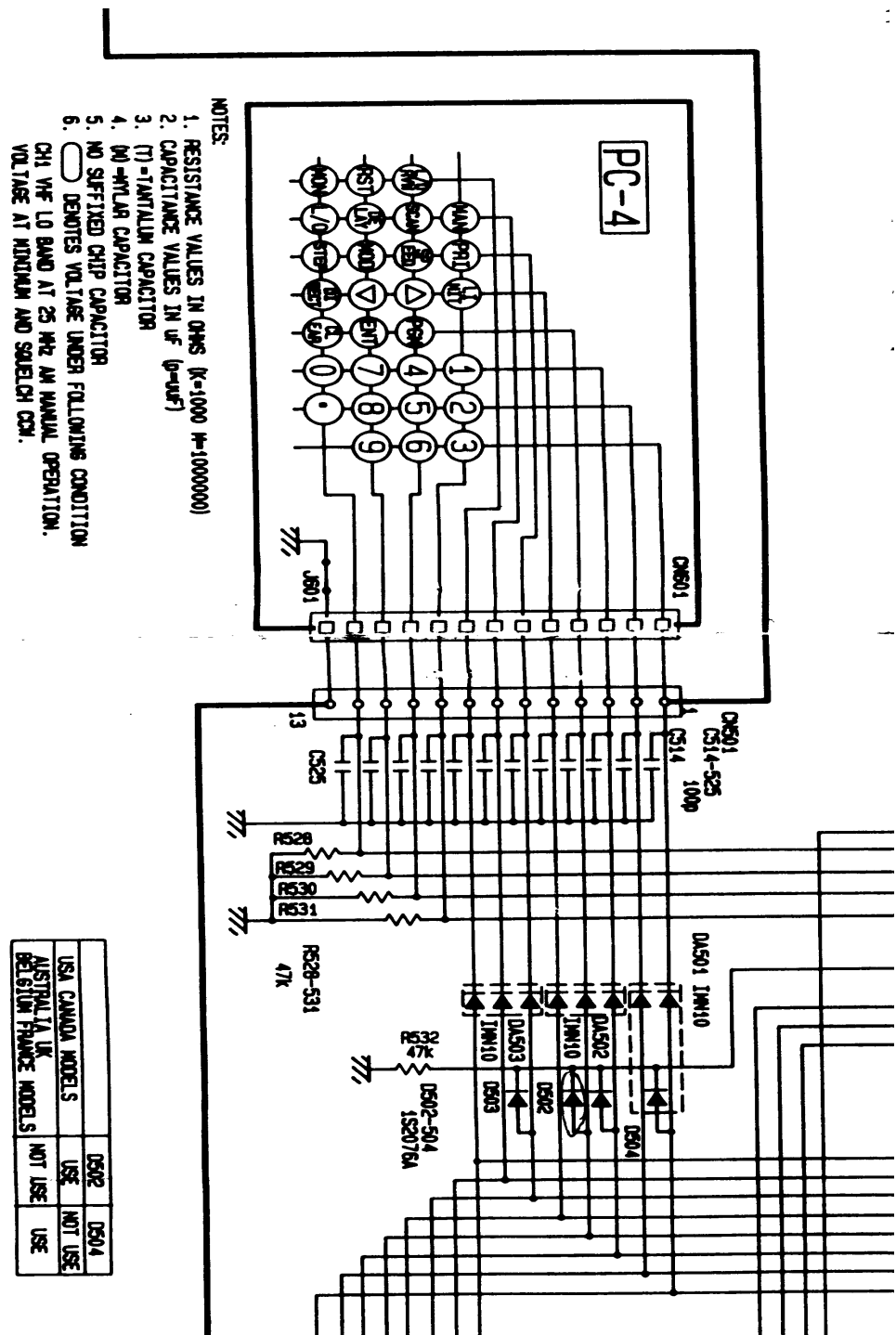


Close-up view of the resistor/diode interface network. The interface's connections are via SIP sockets for ease of disassembly. The SIP sockets are not required, but highly recommended. The RED arrow points to the large, white, 15-pin, front-panel keypad connector. The top pin of the connector (looking down) is *Pin-1*. The metal shields can be soldered to for ground. You'll basically have to take the entire scanner apart to reach everything.



Alternate view. There is a notch cut in the front-panel's metal shield to allow the wires from the keypad's connector to come out. There are small holes (and solder pads) near the connector which you can solder to.

Service Manual Keypad Schematic for a Radio Shack PRO-2006-series Scanner



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End of Issue #10



Any Questions?

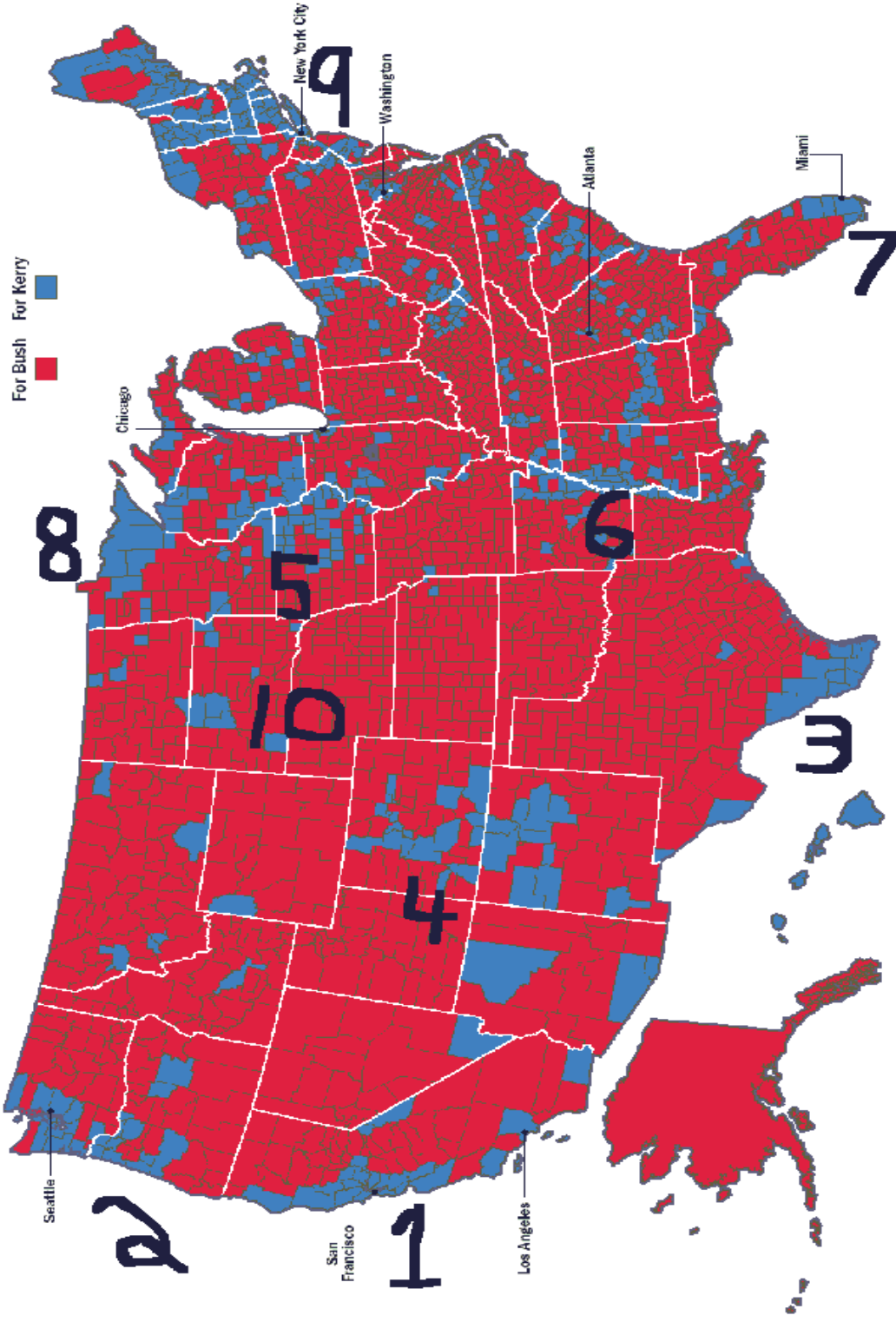
Editorial and Rants

Recently, there was a Presidential election held in the United States. Thankfully, the good guys won, but it was a close race with the bad guys cheating, stealing, and lying – as usual.

There are basically ten major "Demoncrat" voter sections. I've labeled each of them on the following map. There is also a quick description of the general areas for people who may not be familiar with these regions. Notice how the "sKerry" voters (in blue) appear to be a cancer on the United States.

1. Whiny, pampered rich people. Delusional. Lots of crime. Movie stars. Fancy cars. Hottubs and expensive wines. Smelly, useless Mexicans. No one speaks English. They live in their own little worlds.
2. Whiny, pampered rich kids. Hippies. Lazy, homeless, and jobless. Microsoft. Big Foot territory.
3. No one here is in the U.S. legally. No one speaks English.
4. This is where the rich people in regions 1 & 2 buy land or move to when they retire.
5. Communists. The cities in this region smell like dog poop. Trust me on that one.
6. Bad moonshine.
7. Illegal Cubans. Communist and drug lord sympathizers. Senile old rich people who can't read a ballot.
8. Fucking Canadian–savage influence.
9. The worst. Absolute crap hole. Clueless rich people. People pee on the steets. No one understands how a trash can works. Filled with murderers. Home of the "City That Never Showers".
10. I have no clue. Probably stupid people who can't read.

Popular vote by county



Source: Associated Press. Counted by the author.